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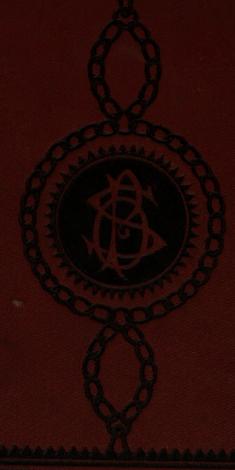


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SHORT AND COMPREHENSIVE COURSE

OF

GEOMETRY AND TRIGONOMETRY;

DESIGNED FOR GENERAL USE IN

SCHOOLS AND COLLEGES.

BY

ANDREW H. BAKER, A.M., Ph.D.

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PREFACE.

EOMETRY, like every other science, has but few principles, which, if systematically arranged and thoroughly developed, may be readily comprehended, and indelibly impressed upon the mind.

Plane Geometry may be said to begin and end with the circle. The angles formed at the center by the radii should be treated of first; next, inscribed angles, and an inscribed triangle; then, a hexagon and an equilateral triangle; inscribed and circumscribed squares; regular and irregular polygons; and finally return to the circle. In the demonstrations of the propositions derived from these figures, every principle of Plane Geometry is developed; and Solid Geometry has no distinct principles.

In teaching Solid Geometry, I much prefer the use of blocks. The beginner, at least, will be greatly benefited by having a material object to inspect and compute, until he becomes thoroughly acquainted with all its properties; after which, he may employ his imagination as he likes, and conceive figures of every shape and form. The system of object teaching favors this method.

In preparing this treatise, I have aimed especially at simplicity and brevity. The former, that it may be within the grasp of every student; the latter, that the memory may not be overburdened, and too much time occupied in acquiring a thorough knowledge of the science.

Although I have stated that beginners derive benefits from material figures, I do not thereby wish to intimate that Geometry

presents no opportunity for the exercise of the imagination; whilst, in truth, no other science presents so wide a field for the exercise of this faculty. We pierce the most distant points of the celestial concave with straight lines, and with arcs of great circles; measure and compute the distance and size of the farthest stars, thereby rendering what appeared imaginary, matters of fact.

Simplicity and brevity are not only important, but they are absolutely necessary, in order that mankind generally may acquire a thorough knowledge of pure mathematics; after which, any branch of applied mathematics may be pursued with ease and advantage.

The design of the Trigonometry is the same as of the Geometry. With these impressions, I dedicate this volume to the American Youth; and if it prove that I have plucked a few thorns from the rugged path of science, and strewn a few flowers therein, I shall not regret the arduous task.

AUTHOR.

ELEMENTS OF GEOMETRY.

BOOK I.

DEFINITIONS.

- 1. Elementary Geometry treats of the properties, relations, and measurement of magnitudes.
 - 2. Magnitudes have one, two, or three dimensions; as, A line has only one dimension, viz., length.

A surface has two, length and breadth.

And a solid has three, length, breadth, and thickness.

3. Plane Geometry takes its name from the plane, as each figure is upon one plane.

REM.—As every figure, and every part of it, is on the same plane, it is not necessary to repeat "on the same plane."

- 4. A Mathematical Plane is a surface of indefinite extent, such that if a straight edge or rule be applied to it, the edge or rule will coincide with it, in every position.
 - 5. Lines are of two classes, straight and curved.
- A Straight Line has everywhere the same direction, or it may be said to have two directions, exactly opposite each other, from any point in the line.
- A Curved Line, or simply a Curve, constantly changes its direction.
 - 6. Surfaces are of two classes, plane and curved.
- A Plane Surface corresponds to the mathematical plane, or a portion of it, and it may have any position whatever; that is, it may be horizontal or vertical, or it may be oblique.
- A Curved Surface is such that if a straight rule be applied to it, the rule will not coincide with it in every position; as the surface of a sphere or of a cylinder.

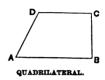
- 7. A Point has position only; as, any particular place in a line or plane, and the extremities of lines, are called points.
- 8. A Circle is a portion of a plane bounded by a curved line, every point of which is equally distant from a point within called the center.
- 9. The curved line is called the Circumference, and any part of it an Arc.
- 10. A Polygon is a portion of a plane bounded by straight lines called *sides*.



A polygon of three sides is called a **Triangle**.

A polygon of four sides is called a Quadrilateral.

A polygon of five sides is called a **Pentagon**.



A polygon of six sides is called a Hexagon, etc.

- 11. The divergence of any two sides from their point of intersection is called an Angle of the polygon; and the number of angles will always be the same as the number of sides of the polygon.
- 12. A triangle having two equal sides is called an Isosceles triangle.

A triangle having three equal sides is called an Equilateral triangle.

A triangle having all its sides unequal is called a Scalene triangle.

- 13. Two lines are Parallel when they are everywhere equally distant, and hence will never meet.
- 14. A quadrilateral having its opposite sides respectively parallel is called a Parallelogram.
- 15. A quadrilateral having only two sides parallel is called a **Trapezoid.**
- 16. A Regular Polygon has all its sides and angles respectively equal.
 - 17. A regular quadrilateral is termed a Square.
- 18. A circle, a polygon, etc., are termed Geometrical 'Figures.

- 19. An Angle may be designated by the letter at its vertex, or by three letters, the letter at the vertex occupying the middle place, and the letters at the extremities of its sides holding the first and last places; thus, the angle A in the triangle ABC is designated angle BAC.
- 20. When the angles of a quadrilateral are right angles, and the opposite sides respectively equal, it is termed a Rectangle.
- 21. The circumference of a circle is divided into 360 equal parts, called **Degrees**, and if radii be drawn to each point marking the degrees, there will be 360 angles, each of one degree.

GEOMETRICAL TERMS.

- 1. An Axiom is a self-evident truth.
- 2. A Theorem is a truth which requires a demonstration.
- 3. A Problem is a question which requires a solution.
- 4. Axioms, Theorems, and Problems are Propositions.
- 5. A Corollary is an obvious consequence of one or more propositions, or of a definition.
- 6. A Scholium is a remark upon something which precedes.

GENERAL AXIOMS.

- 1. Magnitudes which are equal to the same magnitude are equal to each other.
 - 2. If equals be added to equals, the sums will be equal.
- 3. If equals be subtracted from equals, the remainders will be equal.
 - 4. If equals be added to unequals, the sums will be unequal.
- 5. If equals be subtracted from unequals, the remainders will be unequal.
- 6. If equals be multiplied by equals, the products will be equal.
 - 7. If equals be divided by equals, the quotients will be equal.
 - 8. The whole is greater than any of its parts.
 - 9. The whole is equal to the sum of all its parts.
 - 10. Like powers and like roots of equals are equal.

SPECIAL AXIOMS.

- 1. A straight line is the shortest distance between two points.
- 2. Between two points only one straight line can be drawn.
- 3. Two fixed points through which a line passes determinits direction.

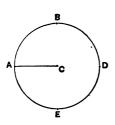
Cor. 1.—Two straight lines, having two points common, form one and the same straight line.

COR. 2.—Two straight lines intersect at but one point.

- 4. Two straight lines, starting from the same point and taking the same direction, form one and the same straight line.
- 5. Two straight lines, starting from the same point and taking different directions, form an angle.
- 6. Two straight lines starting from different points and taking the same direction, are parallel.
- 7. If two lines are each parallel to a third, they will be parallel to each other.
- 8. Only one perpendicular can be drawn to a straight line, either from a point without the line, or from a point on the line.

Describe a circle, and show the relation of its properties, and also that of a straight line touching it at one point.

Take a string of any definite length, say six inches, attach a pin to one end, and a chalk point to the other end. Fasten the pin at any point in a plane as a center, and, with the string at



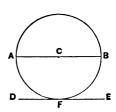
full stretch, revolve the chalk point around the center, until it reaches the point from which it started; thus, let CA represent the string, C the center-pin, and A the chalk-point. ABDE is the chalk-line made by the revolution of CA; every point in the line ABDE will be at the distance CA from the center; the curved line ABDE is the circumference of the circle; the portion of

the plane enclosed by it is the circle; and CA is the radius.

DEF. 1.—Any straight line, as AB, passing through the center and terminating on the circumference, is a **Diameter**.

Cor.—A diameter is twice the radius.

DEF. 2.—Any straight line as DE, touching at but one point as F, is a **Tangent** to the circumference.



REM.—A circumference can be described with a pair of dividers; the distance between the points is the Radius of the circle.

Two radii drawn from the center of a circle to its circumference, form an angle of as many degrees as is

contained in the arc intercepted by its sides.

DEF. 1.—When the angle is 90 degrees, it is called a **Right Angle**.

Def. 2.—When the angle is less than 90 degrees, it is called an Acute Angle.

Def. 3.—When the angle is greater than 90 degrees, it is called an **Obtuse Angle**.

Def. 4.—The Complement of an angle is the difference between the angle and 90 degrees.

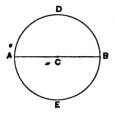
Cor.—If the sum of two angles is 90 degrees, the one is the complement of the other.

DEF. 5.—The **Supplement** of an angle is the difference between the angle and 180 degrees.

Cor.—If the sum of two angles is 180 degrees, the one is the supplement of the other.

THEOREM I.

The diameter of a circle bisects the circle and its circumference.



Let AB be the diameter of the circle ADBE.

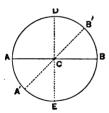
Revolve the part ADB upon AB as an axis, until it falls upon AEB. The arc ADB will coincide with the arc AEB; otherwise some points in the circumference would be unequally distant from the center of the circle; hence the part of the circle ADB is equal to

the part AEB; and the arc ADB is equal to the arc AEB.

Cor.—Each one of the two equal parts of the circle is a semi-circle, and the corresponding arcs are semi-circumferences.

THEOREM II.

An angle at the center of the circle is measured by the arc intercepted by its sides.



Let C be the center and AB the diameter of a circle, A'B' a two-pointed needle, with a pivot at the center C about which it revolves. Since A'B' passes through the center and terminates in the circumference, it is a diameter, and in every position bisects the circle and its circumference (Theorem 1); hence, as A' is moved towards E, B' moves

towards D; the arcs AA' and BB' are constantly equal; and the radii CA and CA', also CB and CB', make equal angles at the center C.

When A' reaches E, 90 degrees from A; B' will be at D, 90 degrees from B; and there will be four equal angles at C, each 90 degrees; and the diameters are said to be at right angles, or perpendicular to each other.

As the arc AA' increases by one, two, etc., degrees, so also the angle ACA' increases by the same number of degrees.

THEOREM III.

If one straight line intersect another straight line, the sum of any two adjacent angles will be equal to two right angles.

Let the two straight lines intersect at C, then with C as a center and any radius describe a circumference cutting the lines at A, E, B and D. Since AB is a diameter, the two angles ACE and ECB will be measured by the sum of the two arcs AE and EB, which is equal to a semi-circumference or



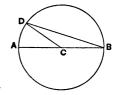
two right angles. So also the two angles ACD and BCD, and since DE is a diameter, the sum of ACD and ACE is equal to two right angles, also the sum of ECB and BCD.

- Cor. 1.—Vertical angles are equal, as each one is the supplement of the same angle; thus, ACD and ECD is each the supplement of ACE, or its equal BCD.
- Con. 2.—The sum of all the angles at a point on each side of a straight line is equal to two right angles; and the sum of all the angles around a point is equal to four right angles.
- Cor. 3.—Equal arcs have equal radii and are like parts of equal circumferences.
- Cor. 4.—Equal angles have equal arcs, and equal arcs have equal chords, the radii being equal.
- Scho.—If several circumferences, with different radii, be described from the same center, the circumferences will be parallel.

THEOREM IV.

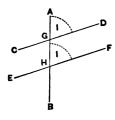
The diameter of a circle is greater than any other chord.

Let AB be the diameter and BD a chord of a circle. Draw the radius CD, which is equal to CA; BD is less than the sum of BC and CD, (Special Axiom 1); but BC + CD = AC + CB = AB; therefore DB is less than AB, or AB > DB.



THEOREM V.

If two straight lines meet a third line, making any two angles which are similarly situated with regard to the two lines, and on the same side of the third line equal, then will the two lines be parallel. The converse is also true.



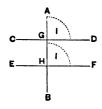
If the two lines CD and EF meet AB, making the angles AGD and AHF equal, then will CD and EF be parallel.

CD and EF may be regarded as starting at different points G and H, and as they make the angles AGD and AHF equal, they take the same direction and are therefore parallel. (Special Axiom 6.)

The converse is necessarily true.

Cor. 1.—The same is true, when the equal angles are right angles; hence, two lines perpendicular to a third are parallel.

Cor. 2.—Since the angles marked 1 and 1 are equal, and their vertical angles are also equal, hence four of these angles are equal; and as each of the remaining four is supplementary to one of these, they are consequently equal.



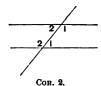
Cor. 3.—If one of these angles is acute, four will be acute, and the other four will be obtuse; but if one is a right angle, all will be right angles.



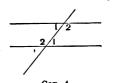
DEF. 1.—Angles similarly situated are called corresponding angles.

COR. 1.—If two parallels are cut by a third line, the corresponding angles will be equal.

COR. 2.—The interior angles on the same side are supplementary.



1/2 Cor. 8.



COR. 3.—The alternate exterior angles are equal.

Cor. 4.—The alternate interior angles are equal.

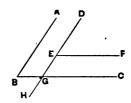
Scho.—In the above figures the same numbers indicate pairs.

THEOREM VI.

Two angles, having their sides parallel and lying in the same or in opposite directions, are equal.

Let AB and DE be parallel, also BC and EF, and lying in the same direction; then will the angles ABC and DEF be equal.

Produce DE to H, cutting BC in G. Since the parallels are cut by DH, the corresponding angles DEF and DGC



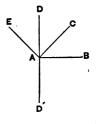
are equal; and as BC cuts the parallels DH and AB, the angles DGC and ABC are corresponding angles and hence are equal; therefore, the angle ABC is equal to the angle DEF. (Ax. 1.)

The angles DGC and BGH are vertical angles, therefore equal. Consequently the angles ABC and BGH are equal.

THEOREM VII.

Two angles, having their sides respectively perpendicular, are equal or supplementary.

Let the sides of the angle EAD be respectively perpendicular to the sides of the angle BAC; and also the sides of EAD' perpendicular to the sides of BAC.



1st. The angles BAD and CAE are right angles; from each take the angle CAD, and there remains the angle BAC equal to the angle DAE.

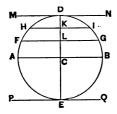
2d. The angle EAD' is supplementary to EAD; so also of its equal BAC.

THEOREM VIII.

If, in a circle, two diameters be drawn at right angles, and several chords be drawn parallel to one of the diameters, and at the extremities of the other diameter, lines be drawn parallel to the chords,

1st. The chords will be bisected by the perpendicular diameter.

- 2d. The lines at the extremities of the same diameter, will be tangents to the circumference.
- 3d. Any two parallels will intercept equal arcs of the circumference.



Since DE is a diameter, DAE is a semicircle, and if it be revolved upon DE as an axis, until it fall upon DBE, the two semicircles will coincide; and since all the angles made with DE by the diameter AB and each line parallel to AB are right angles, all the parts of the lines of the semicircle DAE will fall upon and coincide with those

of the other semicircle; that is, CA with CB; FL with LG; and HK with KI; also MD with DN and PE with EQ; therefore;

1st. The chords are bisected.

- 2d. The two lines MN and PQ can only touch the circumference at D and E respectively; for, at these points, the straight lines and the curves may be regarded as starting and taking different directions, for the straight lines are parallel to the chords, whilst the curves approach and intersect them.
- 3d. As the one half of each chord falls upon its other half, and the one side of each tangent falls upon its other side, so also the intercepted arcs respectively fall upon and coincide with each other, and hence are equal.

Cor. 1.—A radius perpendicular to a chord bisects the chord and also its arc.

COR. 2.—A tangent is perpendicular to a radius at its extremity.

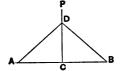
Cor. 3.—A line perpendicular to a chord at its middle point, passes through the center of the circle.

Scho.—Observe that a tangent touches the circumference at but one point, and a chord intersects the circumference at two points, each end passing away in opposite directions; hence a straight line can only intersect a circumference at two points.

THEOREM IX.

If a perpendicular be erected at the middle point of a straight line, every point in the perpendicular is equally distant from the extremities of the line.

Let PC be perpendicular to AB at its middle point C; then will any point in the line PC be equally distant from A and B.



Take any point in the perpendicular. PC as D, and draw AD and BD; and let

the part ACD be revolved on DC as an axis, until it fall upon the plane of BCD; since both angles at C are right angles, CA will take the direction of CB, and as AC is equal to CB, the point A will fall upon the point B, and CA will coincide with CB, and AD must fall upon and coincide with DB. (Special Ax. 2.)

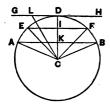
Cor. 1.—As two points determine the direction of a line; any straight line which has two points equally distant from the extremities of another line, is perpendicular to the latter at its middle point.

Cor. 2.—With D as a center and DA as a radius, a circum ference may be described which will pass through the points A and B, and AB becomes a chord of the circumference; and as a straight line cannot intersect a circumference at more than two points, there can be only two points in the line AB equally distant from the point D.



THEOREM X.

A perpendicular is the shortest distance from the center of a circle to a chord, or from a point to a line.



Let AB and EF be two parallel chords, and draw CD perpendicular to AB; it will also be perpendicular to EF. At the point D, the extremity of the radius CD, draw GH perpendicular to CD, and it will be parallel to the chords AB and EF.

1st. The perpendicular CK is less than CA or CB, each of which is equal to CD, of which CK is a part.

CI is less than CE or CF for the same reason.

As the chord departs from the center and consequently diminishes, the perpendicular approaches the radius in length, but can never equal it whilst the chord has any definite length.

2d. CD is less than any oblique line drawn from the point C to GH; for any oblique line as CL will terminate without the circumference, and consequently be greater than the radius.

Cor. 1.—A perpendicular is the shortest distance from a point to a line, and also between two parallels.

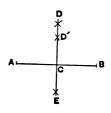
COR. 2.—The farther distant from the center, the less the .chord.

Cor. 3.—The less the chord the less the arc, and consequently the less the opposite angle.

PROBLEM I.

To bisect a given line.

Let AB be the given line; then with A and B as centers, and a radius greater than the half of AB, describe arcs above and below the line AB, intersecting at D' and E, and join D' and E, cutting AB in C, which will be the middle point. (Th. 9, Cor. 1.)



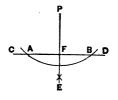
Sch. 1.—The intersections may both be made on the same side of AB, as at D' and D, by taking different radii.

Sch. 2.—As the radius becomes, as it were, an oblique line, whilst one-half of AB is a perpendicular, it must, of course, be greater than one-half of AB.

PROBLEM II.

From a point without a line, to draw a perpendicular to the line.

Let P be a point without the line CD. With P as a center, and a radius greater than the shortest distance to CD, which would be a perpendicular, draw an arc cutting CD in A and B; then with A and B as centers and a radius greater than one-half of AB, describe arcs intersecting at E; then

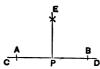


will P and E be two points equally distant from A and B, and hence PE is perpendicular to AB or to CD. (Th. 9, Cor. 1.)

PROBLEM III.

At a point in a line, to erect a perpendicular to the line.

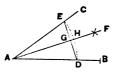
Let P be a point in the line CD; then, with P as a center and a radius PA, cut CD in two points, A and B; and with A and B respectively as centers, and a radius greater than one-half of AB, describe arcs intersect-



ing at E, and join PE. It will be perpendicular to CD at the point P.

PROBLEM IV.

To bisect a given angle.

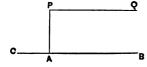


Let BAC be the given angle. Then with A as a center and a radius that will cut the sides AB and AC, draw the arc DE and its chord; then with D and E, respectively, as centers and a radius greater than

the half of DE draw arcs intersecting at F, and join AF. The two points A and F will be equally distant from D and E; hence the line AF will bisect the chord DE, its arc, and hence the angle A.

PROBLEM V.

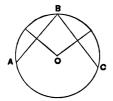
From a point without a line, to draw a parallel to the line.



Let P be a point without the line CB. From P draw PA perpendicular to CB (Prob. 2), and from P draw a perpendicular to AP. Then will PQ be parallel to CB. (Th. 5.)

PROBLEM VI.

To find the center of a given circle.



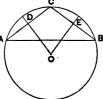
Draw any two chords, as AB and BC, to the given circle, and pass perpendiculars through their middle points; both perpendiculars will pass through the center of the circle. (Th. 8, Cor. 3.) The point of their intersection O, which is the only common point, is the center of the circle.

Scho.—It is not necessary that the chords be consecutive, but they must not be parallel, as then there would be but one perpendicular and the same perpendicular would pass through the middle points of both chords.

PROBLEM VII.

To circumscribe a circle about a triangle.

Let ABC be the given triangle. Pass the perpendiculars DO and EO through the middle points of any two sides of the triangle, as AC and CB; their point of intersection O will be the center of a circle of which AC and CB are chords.



Cor. 1.—A circumference can be passed through any three points not in the same straight line; but if the three points are in the same straight line, only one perpendicular can be drawn, and hence no solution.

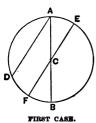
Con. 2.—Each of the three points is equally distant from the center, but only two points in the same straight line can be equally distant from a point without the line. (Th. 9, Cor. 2.)

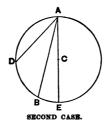
BOOK II.

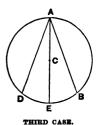
Der.—An Inscribed Angle has its vertex in the circumference of a circle of which its sides are chords.

THEOREM I.

An inscribed angle is measured by one-half the arc intercepted by its sides.







There are three cases:

1st. When one of its sides is a diameter; as, the angle BAD has one side AB a diameter. Through the center C draw EF parallel to the chord AD; then will the angles BAD and BCF be equal, as they are corresponding angles; but BCF and ACE are equal, as they are vertical angles—they are both angles at the center, measured respectively by the arcs FB and AE, which arcs are consequently equal. Therefore arc AE is equal to arc FB, also equal to arc DF; hence FB is one-half of BD. Therefore the angle A is measured by ½ arc BD, which is the arc intercepted by its sides.

2d. When the center of the circle is without the angle, as the angle BAD.

Here angle EAD is measured by ½ arc DE, And "BAE ""½" BE.

By subtraction, "BAD ""½" BD.

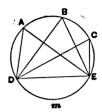
3d. When the center is within the triangle; as BAD.

Here angle BAE is measured by ½ arc BE, And "DAE ""½" DE.

By addition, "BAD ""½ BD.

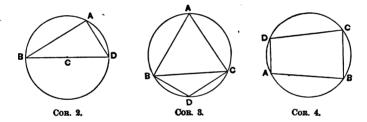
THEOREM I .- CONTINUED.

Cor. 1.—All the angles inscribed in the same segment are equal; since the angles A, B, and C are measured each by the half of the same arc DmE, they are equal.



Cor. 2.—An angle inscribed in a semicircle is a right angle, as BAD.

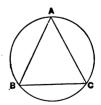
Con. 3.—An angle inscribed in a segment greater than a semicircle is acute, as BAC; and an angle inscribed in a segment less than a semicircle is obtuse, as BDC.



Cor. 4.—The opposite angles of an inscribed quadrilateral are supplementary; as,

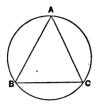
The sum of the two arcs is the circumference; hence half their sum is the measurement of two right angles.

Cor. 5.—If the extremities of the chords forming an inscribed angle be joined by a straight line, an inscribed triangle is formed. As in the angle join B and C; then the triangle ABC has each of its angles inscribed, and is therefore an inscribed triangle.



THEOREM II.

The sum of the three angles of any triangle is equal to two right angles.



Let ABC be an inscribed triangle; then will angles A + B + C equal two right angles; as,

The sum of the three arcs is a circumference, one-half of which measures the angles and is the measure of two right angles; hence, the

sum of the angles of an inscribed triangle is equal to two right angles; but, as a circumference may be passed through all the vertices of any triangle and the triangle become inscribed, (Book I, Problem 7), it follows that the sum of the three angles of any triangle is two right angles.

Cor. 1.—If the triangle is isosceles, two of its angles will be equal.

Cor. 2.—If the triangle is equilateral, all the angles will be equal, each 60 degrees.

Cor. 3.—If the triangle is scalene, all the angles will be unequal.

Con. 4.—As an inscribed angle is measured by half the arc intercepted by its sides, and the greater the arc the greater the chord, hence the greatest angle is opposite the greatest chord and the next to the greatest angle opposite the chord next to the longest, and the smallest angle opposite the shortest chord; consequently, in any triangle the greatest angle is opposite the longest side, the next to the greatest angle opposite the next to the longest side; and the smallest angle opposite the shortest side.

Scho. 1.—If a triangle has two sides and the included angle given, the three vertices of the triangle are fixed, and the triangle determined.

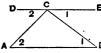
Scho. 2.—One side and the two adjacent angles fix the three vertices, but if one of the given angles be the opposite angle, the other adjacent angle is the supplement of the sum of the two given angles.

Scнo. 3.—The three sides of a triangle also determine the triangle.

Cor.—Two triangles, each having the three parts named in either of the scholia respectively equal, are equal in all their parts.

REM.—The sum of the angles of a triangle may be determined by means of the parallels, as follows:

Let ABC be any triangle. At C draw DF. parallel to AB. The angles marked 1 and 1 and 2 and 2 are respectively alternate interior angles, and consequently respectively equal; hence, the three angles of the triangle are equal to all the angles at a point on one side of a straight line, which is two

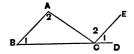


THEOREM III.

If one side of a triangle is produced in one direction, the exterior angle formed is equal to the sum of the two interior angles not adjacent.

Let ABC be a triangle. Produce BC to D, forming the exterior angle ACD. From C draw CE parallel to BA; then will the angles marked 1 and 1 be corresponding angles and equal, and the

right angles. (Book I, Th. 3, Cor. 2.)

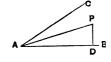


angles marked 2 and 2 be alternate interior angles and equal; hence, the exterior angle ACD is equal to the sum of ABC and BAC, the two interior angles not adjacent.

THEOREM IV.

Every point in the line which bisects an angle is equally distant from each side of the angle.

Let AP bisect the angle A, and revolve the part CAP on AP as an axis; AC will fall upon and coincide with AB, since angle CAP is equal to angle PAD. From any point as P draw PD perpendicular to AB; it will be



the shortest distance to AB, and also to AC, which coincides with AB.

THEOREM V.

If from a point without a line a perpendicular be drawn to the line, and oblique lines to different points of the line:

- 1st. The perpendicular will be shorter than any oblique line.
- 2d. Any two oblique lines at equal distances from the foot of the perpendicular will be equal.
- 3d. The farther from the foot of the perpendicular, the greater the oblique line.



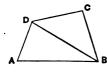
1st. In the triangle ABD, the angle B is a right angle; hence it is greater than the angle D. Therefore the side AB opposite the angle D, is less than the side AD opposite the angle B.

2d. The triangles ABD and ABC have each two sides and the included angle respectively equal; hence the triangles are equal, and AC equal to AD.

3d. In the triangle ACE, the angle ACE is obtuse, consequently greater than the angle AEC; therefore the side AE is greater than the side AC.

THEOREM VI.

The sum of all the angles of any quadrilateral is equal to four right angles.



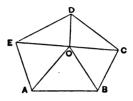
Let ABCD be any quadrilateral. Draw the diagonal DB, dividing the quadrilateral into two triangles. All the angles of the two triangles make up precisely the angles of the quadrilateral; but, the sum of all the

angles of the two triangles is four right angles. Hence, the sum of all the angles of any quadrilateral is four right angles.

THEOREM VII.

The sum of all the angles of any polygon is equal to two right angles taken as many times as the polygon has sides, minus four right angles.

Let ABCDE be any polygon. Take any point within the polygon, as O, and from it draw lines to the extremities of all the sides. The number of triangles will be equal to the number of sides of the polygon. The sum of the angles of each triangle is two right angles; hence,

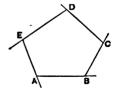


the sum of all the angles of the triangles which make up the polygon, is two right angles taken as many times as the polygon has sides; but all the angles at O, which equal four right angles, belong to the triangles, but not to the polygon, and must be deducted from the sum of all the angles of the triangles, and the difference will be the angles of the polygon; therefore, the sum of all the angles of any polygon is equal to two right angles taken as many times as the polygon has sides minus four right angles.

THEOREM VIII.

If each side of a polygon is prolonged, the sum of all the exterior angles thus formed will be equal to four right angles.

At each vertex of the polygon, the sum of the interior and exterior angles is two right angles; hence, the sum of all the interior and exterior angles is equal to two right angles taken as many times as the polygon has sides, which sum is four right

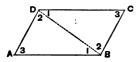


angles more than the sum of all the interior angles. (Th. 8.) Therefore, the sum of all the exterior angles is four right angles.

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THEOREM IX.

The opposite sides and opposite angles of a parallelogram are respectively equal.

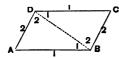


Let ABCD be a parallelogram. Draw the diagonal DB. Since AB and DC are parallels cut by DB, the angles 1 and 1 are alternate and equal; and since AD and BC are parallels cut by DB, the

angles 2 and 2 are alternate and equal. The triangles ABD and BCD have the side BD common and the adjacent angles equal; hence the triangles are equal. Therefore, AB is equal to DC, and AD equal to BC. The angles 3 and 3 are equal, and the sums of the same angles at B and D are equal.

THEOREM X.

If the opposite sides of a quadrilateral are respectively equal, it will be a parallelogram.

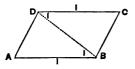


Let AB equal DC, and AD equal BC. Draw the diagonal DB. The triangles ABD and BCD have their three sides respectively equal; hence the triangles are equal, and

the angles opposite the equal sides equal, that is, 1 equals 1, and 2 equals 2, and these are respectively alternate angles; hence, the opposite sides are parallel, and the quadrilateral is a parallelogram.

THEOREM XI.

If two opposite sides of a quadrilateral are equal and parallel, the figure will be a parallelogram.



Let AB and DC be equal and parallel, and draw the diagonal DB.

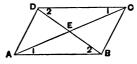
Since AB and DC are parallel, the alternate angles 1 and 1 are equal, and the triangles ABD and DCB have re-

spectively two sides and an included angle equal, and are therefore equal, which makes the other sides equal and parallel, and the opposite angles of the figure equal; hence it is a parallelogram.

THEOREM XII.

The diagonals of a parallelogram mutually bisect each other.

The triangles ABE and DCE have a side and two adjacent angles respectively equal; hence the side AE opposite the angle 2, is equal to EC opposite the angle 2 in the other



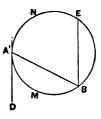
triangle, and DE is equal to EB for the same reason.

THEOREM XIII.

An angle formed by a tangent and a chord is measured by one-half the intercepted arc.

The angle BAD, formed by the tangent AD and the chord AB, is measured by $\frac{1}{2}$ arc AmB.

From B draw the chord BE parallel to the tangent AD, then the angles BAD and ABE are alternate interior angles and consequently equal. The angle ABE is inscribed, and is measured by $\frac{1}{2}$ arc AnE,



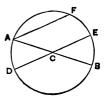
which is equal to the arc AmB, as they are intercepted by two parallels; consequently the angle BAE is measured by $\frac{1}{2}$ arc AmB.

THEOREM XIV.

An angle formed by two chords intersecting within the circle, is measured by one-half the sum of the intercepted arcs.

Let AB and DE be two chords intersecting at C.

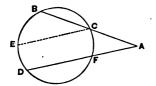
From A draw the chord AF parallel to DE, then will the angles BAF and BCE be corresponding angles, and equal; the angle BAF is inscribed, and is measured by ½ are BEF; but the arc FE is equal to the arc AD,



therefore arc BEF is equal to the sum of the arcs EB and AD; consequently the angle BCE, or its equal ACD, is measured by ½ the sum of the arcs included by its sides.

THEOREM XV.

An angle formed by two secants meeting without the circle, is measured by one-half the difference of the intercepted arcs.



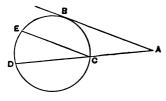
The angle A is formed by the two secants AB and AD.

From C draw CE parallel to AD; BAD and BCE are corresponding angles. The angle BCE is measured by $\frac{1}{2}$ are BE = BD - CF; therefore,

the angle A, formed by two secants meeting without the circle, is measured by one-half the difference of the intercepted arcs.

THEOREM XVI.

An angle formed by a tangent and a secant meeting without a circle, is measured by one-half the difference of the intercepted arcs.

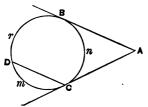


The angle BAD is formed by a tangent and a secant meeting at A. From C draw CE parallel to AB; then the angles BAD and DCE are corresponding and equal; but the angle DCE is inscribed, and measured by 1 arc DE, and DE =

DB — BE, or its equal BC; parallels intercept equal arcs, therefore the angle A is measured by $\frac{1}{2}$ arc DE = $\frac{1}{2}$ arc (DB — BC).

THEOREM XVII.

An angle formed by two tangents meeting without a circle, is measured by one-half the difference of the intercepted arcs.



The angle A is formed by two tangents meeting without the circle. At C draw CD parallel to AB, then the angles BAC and DCE will be corresponding and equal; but the angle DCE is formed by a tangent and a chord, and hence is measured

by $\frac{1}{2}$ arc CmD. (Th. 14.) Arc DmC = (arc BrDmC — arc BrD) and arc BrD = arc BnC; therefore, an angle formed by two tangents intersecting without a circle is measured by one-half the difference of the intercepted arcs.

THEOREM XVIII.

The side of a regular hexagon is equal to the radius of the circumscribed circle.

Describe a circumference and make the chord AB equal to the radius of the circle. Draw the radii CA and CB. CAB will be an equilateral triangle, each side equal to the radius of the circle, and each angle equal to 60 degrees; hence, AB is a chord of an arc of sixty degrees, which is contained exactly six



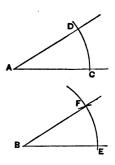
times in the circumference, and is therefore a side of a regular hexagon.

PROBLEM I

To construct an angle equal to a given angle.

Let A be the given angle.

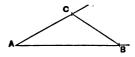
With A as a center and a radius that will cut both sides, describe the arc CD; then, with the same radius and B as a center, describe the arc EF, making it equal to CD, and draw BF; and EBF will be the required angle.



PROBLEM II.

Two sides and the included angle given, to construct a triangle.

Make the angle A equal to the given angle, and on one side lay off AB equal to one of the given sides, and on the other AC equal to the other given side.

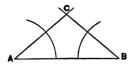


Draw BC, and ABC will be the required triangle.

Cor.—Two triangles having two sides and the included angle respectively equal, are equal in all their parts.

PROBLEM III.

One side and the two adjacent angles given, to construct the triangle.



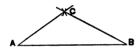
Make AB equal to the given side. At A construct an angle equal to one of the given angles, and at B an angle equal to the other given angle; the intersection C of the lines forming these angles will

be the vertex of the third angle, and ABC will be the required triangle.

Con.—Two triangles having each a side and the two adjacent angles respectively equal, are equal in all their parts.

PROBLEM IV.

To construct a triangle, having given the three sides.



Make AB equal to one of the given sides. Then with A as a center, and a radius equal to one of the given sides, describe an arc; and with B as a center

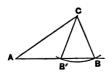
and the other given side, describe an arc intersecting the other arc at C and draw AC and BC, then ABC will be the required triangle.

Con.—Two triangles having their three sides respectively equal, are equal in all their parts.

Scно.—The sum of any two sides of a triangle must be greater than the third side.

PROBLEM V.

Two sides and an angle opposite one of them given, to construct a triangle.



Make the angle A equal to the given angle, and make AC equal to one of the given sides; then with C as a center and a radius equal to the other given side, draw the arc BB', and draw CB and CB'. In

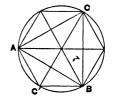
this case there are two triangles.

Scho.—The second side must be equal to or greater than the perpendicular from C to AB. If it is equal, there will be one right-angled triangle; if it be greater than the perpendicular and less than CA, there will be two triangles; but if it be less than the perpendicular, there will be no triangle.

PROBLEM VI.

Form an equilateral triangle.

Describe a circle, and apply the radius six times to the circumference, and draw the chords; the result is a hexagon. Join the alternate vertices, and the result is ABC, an equilateral triangle.



PROBLEM VII.

To construct a regular polygon of eight sides.

Describe a circumference, and divide it into eight equal parts. Draw chords to the equal arcs; they will be the sides of the polygon.

Draw radii from the extremities of the sides to the center of the circle; there will be as many isosceles triangles as the polygon has



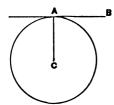
sides. The angles at the center are equal, having equal arcs; and each angle of the polygon is composed of two equal angles of the isosceles triangles; hence, all the angles of the polygon are equal; and the sides being also equal, the polygon is regular.

Con.—A regular polygon of any number of sides may be constructed by dividing the circumference into as many equal parts as there are sides.

REM.—The circumference will be divided into eight equal parts by applying the chord of an arc of 45°.

PROBLEM VIII.

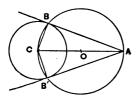
To draw a tangent to the circumference at any point on it.



Let C be the center of a given circle, and A any point in its circumference. Draw the radius CA, and from A draw AB perpendicular to the radius CA; then AB will be the tangent required. (Book 1, Th. 8, Cor. 2.)

PROBLEM IX.

From a point without the circle, to draw a tangent to the circle.

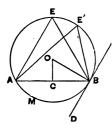


Let C be the center of the given circle, and A the point without the circle from which the tangent is to be drawn. Join the point A and the center C and bisect AC in O; then, with O as a center and the radius OC describe a circumference; the points B and B', the

intersections of the two circumferences, will be the points of tangency, AB and AB' the tangents, as each is a perpendicular to a radius at its extremity; the angles ABC and AB'C being each inscribed in a semicircle.

PROBLEM X.

On a straight line, to construct a segment that shall contain a given angle.



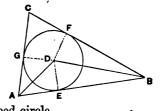
Let AB be the given line. At B make the angle ABD equal to the given angle. Draw BO perpendicular to BD, and at C, the middle point of AB, erect a perpendicular intersecting BO at O; then, with O as a center and radius OB, describe a circumference to which DB is a tangent and AB a chord, and the angle ABD is measured by $\frac{1}{2}$ arc AmB; so also every angle, as E, E',

inscribed in the segment AEB.

PROBLEM XI.

To inscribe a circle in a given triangle.

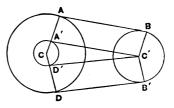
Bisect any two angles as A and B by the straight lines AD and BD, and as every point in each bisecting line is equally distant from the sides of the angle, hence the point of intersection D will be equally distant from the three sides, and DE, DF and DG will be radii of the inscribed circle.



PROBLEM XII.

Draw a common tangent to two external circles of different radii.

Let C and C' be the centers of two circles which are external. With C as a center and a radius equal to the difference of the radii of the circles, describe a small circumference, and from the point C' draw a tangent C'A' to this small circumference; from



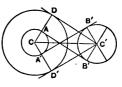
the center C draw a radius through the point of tangency A, and extend it to A in the circumference of the large circle; draw C'B parallel to CA and join AB, which will be the required tangent.

COR —A second tangent B'D may always be drawn.

PROBLEM XIII.

To draw a tangent to two external circumferences of different radii, the tangent passing between the circles and touching at points on the opposite sides of the circumferences.

Let CA and C'B be the radii of the given circles. With C as a center and a radius equal to the sum of the two given radii, draw a circumference. From C'draw C'D and C'D' tangents to the large circle; then draw the radii CD and CD',



cutting the circumference of the smaller given circle in A and A', which will be the points of tangency. From C' draw C'B parallel to CA, and C'B' parallel to CA', and join AB and A'B', and they will be the required tangents.

BOOK III.

PROPORTIONS.

DEFINITION.

When two quantities, each having the form of a fraction, that is, each having a numerator and a denominator, are equal to each other, an equation may be formed of them; and they may be arranged proportionally. In order to show whether the ratio is increasing or decreasing, the denominators should be made the antecedents and the numerators consequents; still, they are in proportion when taken in an inverse order, that is, the numerators as antecedents and the denominators as consequents, but the ratios will be inverted.

 $\frac{\overline{A}}{\overline{A}} = \frac{\overline{C}}{\overline{C}}$

Then will

A : B :: C : D,

and

B: A :: D: C.

This proportion is made very simple by an arithmetical solution; thus,

 $\frac{10}{5} = \frac{12}{6}$

By reduction,

 $\frac{2}{1}=\frac{2}{1},$

and

1:2::1:2.

The same proportion as 5:10::6:12,

or

2:1::2:1,

and

10:5::12:6.

The equation is true if the fractions are inverted; thus,

$$\frac{5}{10} = \frac{6}{12}$$
, and $\frac{1}{2} = \frac{1}{2}$; \therefore 2:1::2:1.

Proportions are much used in Geometry, and should therefore be carefully studied.

Instead of two equal ratios there may be many, in which case they are termed continued proportions; as,

$$\frac{B}{A} = \frac{D}{C} = \frac{F}{E} = \frac{H}{G} = \frac{K}{I}$$
, etc.

Which may be rendered,

This is read: as A is to B, so is C to D, so is E to F, so is G to H, so is I to K. The antecedent and consequent form a couplet, and in a continued proportion any two couplets, may be taken to form a proportion of four terms, which is always considered a proportion, and the first and last terms are called extremes, and the second and third the means.

THEOREM I.

If four quantities are proportional, the product of the means equals that of the extremes.

If A:B::C:D,
$$\frac{B}{A} = \frac{D}{C}.$$

Clearing of fractions or multiplying both members by A and C (Gen. Ax. 6), BC = AD.

COR. 1.—B: A:: D: C; that is, if four quantities are in proportion, they are also in proportion by inversion.

Cor. 2.—They are also in proportion by alternation; thus, $\frac{B}{A} = \frac{D}{C}$. Multiplying both members by $\frac{C}{B}$, $\frac{BC}{AB} = \frac{CD}{BC}$; reducing, $\frac{C}{A} = \frac{D}{B}$; therefore, A : C :: B : D, and again by inversion,

C: A :: D: B.

THEOREM II.

A mean proportional between two quantities is equal to the square root of their product.

Let B be a mean proportional between A and C; as,

The product of the means is equal to that of the extremes; thus,

$$B^2 = A \times C$$
.

Extracting the root of both members,

$$B = \sqrt{A \times C}$$
.

THEOREM III.

If the product of two quantities equals the product of two other quantities, either of the two forming a product may be made the means, and the other two the extremes of a proportion.

Let
$$B \times C = A \times D$$
;

divide by $A \times C$, then

$$\frac{B \times C}{A \times C} = \frac{A \times D}{A \times C} = \frac{B}{A} = \frac{D}{C},$$

$$A : B :: C : D,$$

$$C : D :: A : B.$$
(1)

and or

In the first proportion, A and D are the extremes, and B and C the means; in the second, B and C are the extremes, and A and D the means.

THEOREM IV.

If four quantities are proportional, they will also be proportional by composition and division.

If
$$\frac{B}{A} = \frac{D}{C}$$
, then $\frac{B}{A} + 1 = \frac{D}{C} + 1$, and $\frac{B}{A} - 1 = \frac{D}{C} - 1$.

Reducing to improper fractions,

$$\frac{B+A}{A} = \frac{D+C}{C}$$
, and $\frac{B-A}{A} = \frac{D-C}{C}$,

and A: B+A:: C: D+C; also, A: B-A:: C: D-C. By alternation,

$$A : C :: B + A : D + C$$
; also, $A : C :: B - A : D - C$.

$$\frac{C}{A} = \frac{D+C}{B+A}$$
; also, $\frac{C}{A} = \frac{D-C}{B-A}$.

Gen. Ax. 1,
$$\frac{D+C}{B+A} = \frac{D-C}{B-A}$$
; : B+A:D+C::B-A:D-C.

By alternation, B + A : B - A :: D + C : D - C.

THEOREM V.

Like powers and like roots of proportional quantities are proportional.

Squaring both sides,
$$\frac{B}{A} = \frac{D}{C}$$
; then $\frac{B^2}{A^2} = \frac{D^2}{C^2}$, and $\frac{B^n}{A^n} = \frac{D^n}{C^n}$, and $\frac{B^{\frac{1}{n}}}{A^{\frac{1}{n}}} = \frac{D^{\frac{1}{n}}}{C^{\frac{1}{n}}}$. (Gen. Ax. 10.)
$$\therefore A^2 : B^2 :: C^2 : D^2, \text{ and } A^n : B^n :: C^n : D^n,$$
 and $A^{\frac{1}{n}} : B^{\frac{1}{n}} :: C^{\frac{1}{n}} : D^{\frac{1}{n}}.$

THEOREM VI

Any equimultiple of one couplet will be proportional to the other couplet or to any equimultiple of it.

This depends upon the principle that multiplying both numerator and denominator of a fraction by the same quantity does not change its value.

$$\frac{B}{A} = \frac{D}{C}$$
, and $\frac{mB}{mA} = \frac{D}{C} = \frac{nD}{nC}$.

THEOREM VII.

If the corresponding terms of two proportions be multiplied, their products will be proportional.

A: B:: C: D

E: F:: G: H

$$\frac{B}{A} = \frac{D}{C},$$

$$\frac{F}{E} = \frac{H}{G};$$
hence (Gen. Ax. 6),
$$\frac{BF}{AE} = \frac{DH}{CG}.$$

$$\therefore AE: BF:: CG: DH.$$

THEOREM VIII.

In a series of proportions, as one antecedent is to its consequent, so is the sum of all the antecedents to the sum of all the consequents.

A: B:: C: D:: E: F:: G: H, etc.

$$AD = BC$$
 $AF = BE$
 $AH = BG$
 $AB = BA$
 $A(B+D+F+H) = B(A+C+E+G)$

A: B:: A+C+E+G: B+D+F+H.

Cor. 1.—If any two proportions have an equal ratio, then the other terms are proportional.

Cor. 2.—The same is true if the antecedents are the same in two proportions.

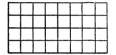
BOOK IV.

THEOREM I.

The area of a rectangle is equal to the product of its base and altitude.

There may be three cases:

1st. When the base and altitude are composed of units of the same denomination; then it is evident that there will be as many square units for every unit in alti-



4

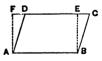
tude as there are units in the base; and for every additional unit in altitude as many more square units; hence the area will be the product of the base and altitude.

- 2d. If there be a fraction in one or both the dimensions, the common denominator will be the denomination of the unit of measure; hence, the product of the base and altitude will give the area, in units of the same denomination.
- 3d. If the dimensions are incommensurable, the unit of measure will be an infinitesimal.

THEOREM II.

The area of a parallelogram is equal to the product of its base and altitude.

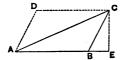
Let ABCD be a parallelogram, AB its base, BE its altitude, its area = AB × BE. Construct the rectangle ABEF; its area = AB × BE. FE = AB and DC = AB, ... FE = DC, and taking from each DE, there



remains FD = EC; hence the triangles ADF and BCE are equal, having all their sides equal. In changing the parallelogram into the rectangle, we have added and subtracted the same area; hence the parallelogram is equal to the rectangle. ... the area of the parallelogram is AB × BE, product of base and altitude.

THEOREM III.

The area of a triangle is equal to one-half the product of the base and altitude.



Area ABC = $\frac{1}{2}$ (AB × CE).

Let ABC be the given triangle, AB its base, and EC its altitude. Construct a parallelogram on AB as one of its sides and BC as another, draw AD parallel to

BC and CD parallel to AB; then will ABCD be a parallelogram. The triangles ABC and ACD will have their three sides respectively equal; hence the triangles are equal and each is one-half of the parallelogram ABCD; and as the area of the parallelogram is AB \times CE, that of the triangle is $\frac{1}{2}$ (AB \times CE); therefore, the area of a triangle is equal to one-half the product of the base and altitude.

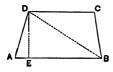
Cor. 1.—Rectangles, parallelograms and triangles are to each other as the products of their bases and altitudes respectively.

Cor. 2.—If the bases are equal, they are to each other as their altitudes.

Con. 3.—If the altitudes are equal, they are to each other as their bases.

THEOREM IV.

The area of a trapezoid is equal to the product of its altitude and half the sum of its parallel bases.



Let ABCD be a trapezoid, DE its altitude, and AB and DC its parallel bases. Draw the diagonal DB, dividing the trapezoid into two triangles whose common altitude is DE and their bases AB and DC.

The area of the triangle ABD = $\frac{1}{2}$ (AB × DE), " " " BCD = $\frac{1}{2}$ (DC × DE), By addition, area of ABCD = DE $\frac{1}{2}$ (AB + DC).

That is, the area of a trapezoid is equal to the product of its altitude and $\frac{1}{2}$ the sum of its bases.

THEOREM V.

The square described on the sum of two lines, is equivalent to the sum of the squares of the lines, increased by twice the rectangle of the lines.

ACDE is the square described on the sum of AB and BC; and corresponds to the algebraic formula $(a + b)^2 = a^2 + 2ab + b^2$, in which AB = a and BC = b.



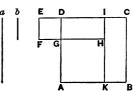
Con.—If the lines are equal there will be four equal squares. Let AB = 1 and BC = 1; then the square of two is four times the square of one.



THEOREM VI.

The square described on the difference of two lines, is equivalent to the sum of the squares of the lines, diminished by twice the rectangle of the lines.

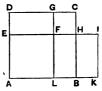
AB =
$$a$$
, KB = b ,
 $(a-b)^2 = a^2 - 2ab + b^2$,
ABCD = a^2 , EDFG = b^2 ,
BCIK = ab , and EIFH = ab ,



THEOREM VII.

The rectangle contained by the sum and difference of two lines, is equivalent to the difference of their squares.

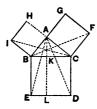
AB =
$$a$$
, and LB = BK = b ,
 $a + b =$ AK, and $a - b =$ AE = AL,
 $(a + b) \times (a - b) = a^2 - b^2$,
ABCD = a^2 , and FHGC = b^2 ,



The rectangle EFGD = rect. BKIH =
$$b$$
 ($a - b$),
" " ABHE = a ($a - b$),
By addition, AKIE = $(a + b)$ ($a - b$).

THEOREM VIII.

The square described on the hypothenuse of a rightangled triangle, is equivalent to the sum of the squares of the other two sides.



Let ABC be a triangle, right-angled at A, then will $\overline{BC}^2 = \overline{AB}^2 + \overline{AC}^2$,

Construct a square on each side of the triangle. From A draw a perpendicular to BC and extend it to ED, and draw AE, AD, IC and BF. The triangles ABE and IBC have two sides respectively equal, viz., AB = BI and BC = BE, being respectively sides of the

same square, and the included angles equal; that is, ABE = IBC, as each one is composed of the angle ABC and a right angle; hence, triangle ABE = triangle IBC; but triangle ABE is one-half the rectangle BELK, having the same base and altitude BE and BK; and the triangle IBC is one-half the square ABIH = $IB \times AB = \overline{AB}^2$; therefore, $\overline{AB}^2 = \text{rectangle BELK}$.

By the same process, we prove the triangle $\overline{BCF} = \overline{ACD}$, and the square $\overline{ACFG} = \text{rect. CDLK}$; therefore, $\overline{BC}^2 = \overline{AB}^2 + \overline{AC}^2$. And by transposing,

COR. 1. $\overline{BC}^2 - \overline{AB}^2 = \overline{AC}^2$, and $\overline{BC}^2 - \overline{AC}^2 = \overline{AB}^2$.



Con. 2.—The square described on the diagonal of a square is double the square described on the side, as the sides are equal; hence, the square of diag.: sq. of side :: 2:1, and diag.: sidé :: $\sqrt{2}:1$.

Cor. 3. Since $\overline{AB}^2 = \text{rect.}$ BELK, and $\overline{AC}^2 = \text{rect.}$ CDLK, the resulting proportion $\overline{AB}^2 : \overline{AC}^2 :: BK : KC$; that is, the squares of the sides are proportional to their adjacent segments of the hypothenuse. And $\overline{BC}^2 : \overline{AB}^2 :: BC : BK$, and $\overline{BC}^2 : \overline{AC}^2 :: BC : KC$; that is, the square of the hypothenuse is to the square of either side as the hypothenuse is to the segment adjacent to the side.

Scho.—Observe, that if the right angle A be diminished, the sides about it remaining the same, the third side BC will be diminished; and if the angle A be increased, BC will be increased; in the first case the square of BC will be less, and in the second greater than the sum of the other two; hence, the right-angled triangle is the only one in which the square of one side is equivalent to the sum of the squares of the two.

THEOREM IX.

In any triangle, the square of a side opposite an acute angle is equivalent to the sum of the squares of the two other sides, minus twice the rectangle of the base, and the distance from the acute angle to the foot of the perpendicular let fall from the vertical angle on the base, or the base produced.

In the triangle ABC the side AB is opposite the acute angle C; hence,

$$\overline{AB}^2 = \overline{AC}^2 + \overline{BC}^2 - 2BC \times CD;$$

the perpendicular falling on the base,

$$BD = BC - DC$$
.

Squaring both members,

$$\overline{BD}^2 = \overline{BC}^2 + \overline{DC}^2 - 2BC \times DC$$

and by adding \overline{AD}^2 to each member,

$$\overline{BD}^2 + \overline{AD}^2 = \overline{BC}^2 + \overline{DC}^2 + \overline{AD}^2 - 2BC \times DC;$$

and by Theorem 8,

$$\overline{AB}^2 = \overline{BC}^2 + \overline{AC}^2 - 2BC \times DC.$$

The same process will give the same result, when the perpendicular falls upon the base produced.



THEOREM X.

In an obtuse-angled triangle, the square of the side opposite the obtuse angle is equivalent to the sum of the squares of the two other sides, plus twice the rectangle of the base and the distance of the obtuse angle from the foot of the perpendicular let fall from the vertical angle on the base produced.

Enunciation,

$$\overline{AC}^2 = \overline{AB}^2 + \overline{BC}^2 + 2BC \times BD,$$

 $CD = BC + BD;$

by squaring,

$$\overline{CD}^2 = \overline{BC}^2 + \overline{BD}^2 + 2BC \times BD;$$

adding AD2 to each side,

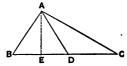
$$\overline{CD}^2 + \overline{AD}^2 = \overline{BC}^2 + \overline{BD}^2 + \overline{AD}^2 + 2BC \times BD.$$

Theorem 8.
$$\overline{AC}^2 = \overline{BC}^2 + \overline{AB}^2 + 2BC \times BD$$
.



THEOREM XI.

If from the vertex of any angle of a triangle, a line be drawn to the middle point of the opposite side, then twice the square of the bisecting line, plus twice the square of half the bisected side, will be equal to the sum of the squares of the two other sides.



From the vertex A of the triangle. ABC draw AD to the middle point of BC; then will

$$2\overline{\mathsf{A}\mathsf{D}^2} + 2\overline{\mathsf{B}\mathsf{D}^2} = \overline{\mathsf{A}\mathsf{B}^2} + \overline{\mathsf{A}\mathsf{C}^2}.$$

In the triangle ADC, the side AC is opposite the obtuse angle ADC.

$$: \quad \overline{AC^2} = \overline{AD^2} + \overline{DC^2} + 2DC \times DE.$$
 (1)

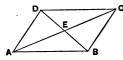
And in the triangle ABD the side AB is opposite the acute angle ADB.

$$\overline{AB}^2 = \overline{AD}^2 + \overline{BD}^2 - 2BD \times DE.$$
 (2)

By adding equations (1) and (2), and observing that BD = DC,

$$\overline{AB}^2 + \overline{AC}^2 = 2\overline{AD}^2 + 2\overline{BD}^2$$
.

Cor.—The sum of the squares of all the sides of a parallelogram, is equivalent to the sum of the squares of the diagonals.



Since the diagonals mutually bisect each other,

By addition,
$$\overline{AB}^2 + \overline{DC}^2 + \overline{BC}^2 = 2\overline{CE}^2 + 2\overline{DE}^2$$
,

$$\overline{AB}^3 + \overline{AD}^2 = 2\overline{AE}^2 + 2\overline{DE}^2$$
.
$$\overline{AD}^2 + \overline{BC}^2 = 4\overline{AE}^2 + 4\overline{DE}^2$$

(Th. 8, Cor. 2.)
$$= \overline{AC^2 + BD^2}.$$

THEOREM XII.

If a line be drawn parallel to one of the sides of a triangle cutting the other sides, it will divide them proportionally.



Draw DE parallel to BC, and draw BE and DC; then the triangles DEB and DEC have the same base DE and the same altitude, as both their vertices are in the line BC, parallel to DE; hence, they are equivalent.

The triangles ADE and BDE having the same altitude, as they have a common vertex E, are to each other as their bases; hence.

ADE : BDE :: AD : BD.

The triangles ADE and DEC have a common vertex D; hence,

ADE : DEC :: AE : EC;

but triangle DEB = triangle DEC, and the two proportions have an equal ratio;

.. AD : BD :: AE : EC,

and by composition,

Con. 1. AD+BD:BD::AE+EC:EC;

that is, AB: BD:: AC: EC,

and AD+BD:AD::AE+EC:AE,

that is, AB: AD:: AC: AE.

COR. 2.—If any number of lines be drawn parallel to a side of a triangle, the other sides will be cut proportionally.



Cor. 3.—If any number of lines be cut by the parallels, they will be cut proportionally.



THEOREM XIII.

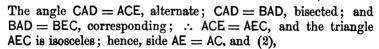
A line which bisects an angle of a triangle, divides the opposite side into segments proportional to the adjacent sides.

Let AD bisect the angle A; then

BD : DC :: AB : AC. (1)

From C draw a line parallel to DA, intersecting BA produced in E; then



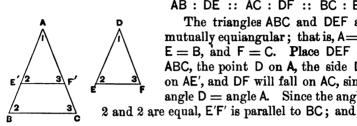


BD : DC :: AB : AC = AE.

or,

THEOREM XIV.

Triangles which are mutually equiangular have the sides opposite the equal angles respectively proportional, and hence the triangles are called similar.



AB : DE :: AC : DF :: BC : EF. The triangles ABC and DEF are mutually equiangular; that is, A=D, E = B, and F = C. Place DEF on ABC, the point D on A, the side DE on AE', and DF will fall on AC, since angle D =angle A. Since the angles

AB : AC :: AE' : AF'.

AB : AC :: DE : DF;

AB : DE :: AC : DF. and by alternation,

By placing F on C, we obtain the proportion,

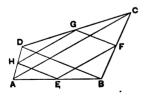
AC : DF :: BC : EF.

Cor.—Two triangles having two angles respectively equal are similar.

REM.—The sides opposite the equal angles are called homologows.

THEOREM XV.

The figure formed by joining the middle points of any quadrilateral by straight lines is a parallelogram.



Let ABCD be any quadrilateral. Join the middle points of the sides, and draw the diagonals.

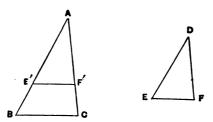
> BE : BF :: EA : FC AE: AH :: EB: HD DH: DG:: HA: GC

CF: CG:: FB: GD.

It follows that GF is parallel to DB, and HE is also parallel to DB. .: GF and HE are parallel; so also EF and HG are parallel.

THEOREM XVI.

Two triangles which have their sides respectively proportional are similar.



Since the sides are respectively proportional, then

Make AE' = DE, and draw E'F' parallel to BC; then will

$$AB : AE' :: AC : AF' :: BC : E'F';$$
 (2)

but AE' = DE.

The proportions (1) and (2) have an equal ratio, hence the other ratios must be the same; hence

AF' = DF

and

$$E'F' = EF;$$

: the triangle AE'F' = DEF;

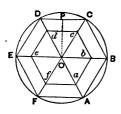
but the triangles AE'F' and ABC are equiangular, as E'F' is parallel to BC; and as they are equiangular they are similar.

Cor. 1.—If two triangles have each an equal angle included by proportional sides, they are similar.

Cor. 2.—Two triangles which have their sides respectively parallel or perpendicular to each other are similar.

THEOREM XVII.

Regular polygons of the same number of sides are similar figures.



Construct a regular polygon, as in Problem VII, Book II, and let a smaller one be placed upon it, the angles being the same in both polygons; they will also be the same in the isosceles triangles; consequently the sides AB and ab, also BC and bc, etc., will be parallel; hence the proportions,

AB : ab :: R : r

BC:bc::R:r, etc.

.. the triangles are similar; and as each polygon is composed of an equal number of similar triangles, the polygons are similar.

Con. 1.—It is evident that a circumference may be inscribed in the polygon, as the perpendicular OP, which is called the apothegm of the polygon is the distance from the center to each side.

Cor. 2.—As the equal sides of the isosceles triangles become radii of the circumscribed circle, a circle may be passed through all the vertices.

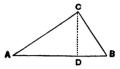
COR. 3.—Circles are similar figures.

Def.—Two polygons which are mutually equiangular and have their corresponding sides proportional, are similar.

THEOREM XVIII.

In a right-angled triangle, if a line be drawn from the right angle perpendicular to the hypothenuse, it will divide the given triangle into two triangles, similar to the given triangle and similar to each other.

Let ABC be right-angled at C, and CD perpendicular to the hypothenuse AB. The triangles ABC and ADC have the angle A common, and each has a right angle; they are therefore similar. And for the same reason ABC and BCD are



for the same reason ABC and BCD are similar; consequently, ADC and BCD are similar.

Cor. 1. Since ABC and ADC are similar,

AB : AC :: AC : AD,

$$AB \times AD = \overline{AC^2}$$
. (1)

Since ABC and BCD are similar,

AB : BC :: BC : BD,

$$AB \times BD = \overline{BC}^{2}.$$
(2)

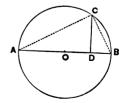
Since ADC and BCD are similar.

AD : DC :: DC : BD; (3)
$$\overline{DC}^2 = AD \times BD.$$

whence, $\overline{DC}^2 = AD \times BD$. Adding (1) and (2), $\overline{AB}^2 = \overline{AC}^2 + \overline{BC}^2$.

From proportions (1) and (2), the result is that the square of the hypothenuse is equivalent to the sum of the squares of the other sides; and from (3), that the perpendicular is a mean proportional between the segments of the hypothenuse.

Con. 2. If from any point in the circumference of a circle a perpendicular be drawn to the diameter, it will be a mean-proportional between the segments of the diameter.

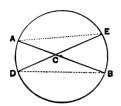


Let C be the point in the circumference from which is drawn the perpendic-

ular CD to the diameter AB; by drawing AC and CB, ABC becomes right-angled at C; hence, $\overline{CD^2} = AD \times BD$. (3)

THEOREM XIX.

If two chords intersect each other in a circle, their segments are reciprocally proportional.

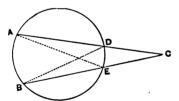


The triangles ACE and BCD are similar; the angle E = angle B, and A = D, respectively measured by ½ the same arc; hence, AC: DC:: CE: BC.

Con. AC \times BC = DC \times CE, the product of the segments of the one chord equal to the product of the segments of the other chord.

THEOREM XX.

If from a point without a circle, two secants be drawn terminating in the concave arc, the whole secants will be reciprocally proportional to their external segments.



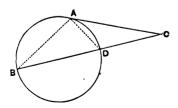
In the similar triangles ACE and BCD,

AC : BC :: CE : DC.

COR. $AC \times DC = BC \times CE$.

THEOREM XXI.

If from a point without the circle a tangent and a secant be drawn, the tangent will be a mean proportional between the whole secant and its external segment.



The similar triangles ABC and ACD give the following proportion:

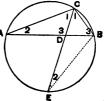
CB: AC :: AC : CD;

hence, $CB \times CD = AC^2$.

THEOREM XXII.

If a line be drawn bisecting an angle of a triangle and intersecting the opposite side, the rectangle of the sides about the bisected angle equals the rectangle of the segments of the third side plus the square of the bisecting line.

Circumscribe a circle about the given triangle ABC, and bisect the angle C and extend the bisecting line to the circumference of the circle and draw BE. The triangles ADC and BCE are similar; hence,



AC : CE :: CD : BC;

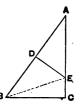
$$\therefore \quad AC \times BC = CE \times CD;$$
but
$$CE = CD + DE,$$
and
$$(CD + DE) \times CD = DE \times CD + \overline{CD}^{2},$$
and
$$DE \times DC = AD \times DB.$$

$$\therefore \quad AC \times BC = AD \times BD + \overline{CD}^{2}.$$

THEOREM XXIII.

Two triangles, having an angle in each equal, are to each other as the rectangles of the sides containing the equal angles.

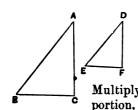
Let the triangles ABC and ADE have the angle A common; then will ABC: ADE:: AB × AC: AD × AE. Draw BE; then the triangles ABE and ADE have the same altitude, and hence ABE: ADE:: AB: AD; the triangles ABC and ABE have the same altitude, ABC: ABE:: AC: AE. Multiplying the proportions and observing that ABE is common to antecedent and consequent,



ABC : ADE :: $AB \times AC : AD \times AE$.

THEOREM XXIV.

Similar triangles are to each other as the squares of their homologous sides.



Let ABC and DEF be similar triangles; angle A = angle D,

ABC : DEF :: $AB \times AC$: DE \times DF. (1) AB : DE :: AC : DF. (2)

Multiplying this proportion by the identical pro-

$$AB \times AC : DE \times DF :: \overline{AC}^2 : \overline{DF}^2$$
 (4)

Since the 1st and 4th have equal ratios,

and as the homologous sides are proportional, so also the triangles are to each other as

$$\overline{AB}^2 : \overline{DE}^2$$
 and $\overline{BC}^2 : \overline{EF}^2$.

Cor. 1.—The areas of regular polygons are to each other as the squares of the radii of the inscribed or circumscribed circle.

Cor. 2.—The areas of circles are to each other as the squares of their radii, or the squares of the diameters.

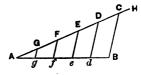
GENERAL COROLLARIES.

- 1. The perimeters of similar polygons are to each other as their homologous sides, or as their corresponding diagonals.
- 2. The perimeters of regular polygons of the same number of sides are to each other as the radii of the inscribed or circumscribed circles.
- 3. The circumferences of circles are to each other as their radii or diameters.

PROBLEM I.

To divide a given line into five equal parts.

Let AB be the given line. From A draw an indefinite line AH, making any angle with AB, and on it lay off the same distance five times. Join the last point C with B, and from each point draw lines parallel to CB: then AB will

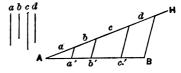


draw lines parallel to CB; then AB will be divided into five equal parts. (Th. 12, Con. 2.)

PROBLEM II.

To divide a given line into parts proportional to several given lines.

Let AB be the given line. Draw AH an indefinite line, and on it lay off the several given lines a, b, c, d, and join the last point with B, and from each point

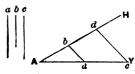


draw lines parallel to this line; then will the parts Aa', a'b', b'c', and c'B be proportional to the given lines a, b, c, and d.

PROBLEM III.

To find a fourth proportional to three given lines.

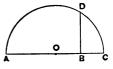
From any point, as A, draw two indefinite lines AH and AY; on AY lay off a, and on AH lay off b and join ab; on AY lay off c and draw cd parallel to ab; bd will be a fourth proportional.



PROBLEM IV.

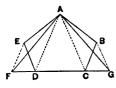
To construct a mean proportional to two given lines.

On an indefinite line lay off AB and BC, equal respectively to the given lines. On AC describe a semi-circumference, and at B erect the perpendicular BD, which will be a mean proportional between AB and BC. (Th. 18, Cor. 2.)



PROBLEM V.

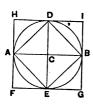
To construct a triangle equivalent to a given polygon.



Let ABCDE be the given polygon. From A draw the diagonals AD and AC; then from E and B draw EF and BG, respectively parallel to the diagonals AD and AC, intersecting the base produced; then AFG will be the required triangle.

PROBLEM VI.

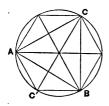
To inscribe a square in a circle and circumscribe a square about a circle.



Draw two diameters at right angles and join their extremities, and we have an inscribed square, as each side is a chord of ninety degrees, and each angle is measured by one-half a semi-circumference. At each extremity of the perpendicular diameters draw tangents to the circumference and we have the circumscribed square.

Cor. 1.—The circumscribed square has double the area of the inscribed, as it has eight equal triangles, whilst the inscribed has only four of the equal triangles; hence, area of cir. sq.: area of ins. sq. :: 2:1, and side of cir. sq.: side of ins. sq. :: $\sqrt{2}:1$; same result as in Th. 8. Cor 2.

Scho.—The side of the circumscribed square is the same as the diagonal of the inscribed.



Cor. 2.—In the triangle CBC', right-angled at B, we have

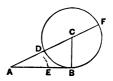
$$\overline{CC^7}^2 - \overline{C^7B}^2 = \overline{CB}^2.$$
 $CC' = 2$, and $C'B = 1$.
 $\therefore \quad 4 - 1 = \overline{CB}^2,$
and
 $\overline{CB}^2 = 3,$
 $CB = \sqrt{3}.$

That is, The side of an equilateral triangle: Radius:: $\sqrt{3}$: 1.

PROBLEM VII.

To divide a given line into extreme and mean ratio; that is, into two such parts that the greater part shall be a mean proportional between the whole line and the less part.

Let AB be the given line. At B erect a perpendicular BC equal to $\frac{1}{2}$ AB; and with C as a center and radius CB, describe a circumference. From A draw AF through the center and terminating in the concave arc, and with A as a center and AD as radius, draw the arc



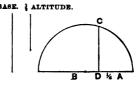
DE, making AE equal to AD; then DF = AB, and (Theorem 21) AF: AB:: AB: AD, by inversion AB: AF:: AD: AB, and by division AB: AF — AB:: AD: AB — AD; that is, AB: AD:: AD: EB, or AB: AE:: AE: EB.

PROBLEM VIII.

To construct a square equivalent to a given triangle.

A mean proportional between the base and half the altitude of the triangle will be a side of the square.

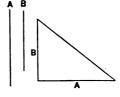
Let B = Base and A = $\frac{1}{2}$ Altitude. DC is a mean proportional between base and one-half altitude.



PROBLEM IX.

To construct a square equivalent to two given squares.

Construct a right angle. On one of the sides of the angle lay off a distance equal to a side of one of the squares; and on the other side of the angle a distance equal to a side of the other square, and draw the hypothenuse; it will be a side of the required square.



REM.—By this principle the side of a square equivalent to any number of squares may be found.

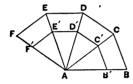
Cor.—By making the longer side the hypothenuse, the third side will be the side of a square equal to the difference of two squares.

REM. 1.—If similar polygons be constructed on the three sides of a right-angled triangle, the given sides being homologous, the polygon constructed on the hypothenuse will be equivalent to the sum of the two others.

REM. 2.—To construct a square equivalent to a given polygon, reduce the polygon to an equivalent triangle and find a mean proportional between the base and half the altitude of the triangle.

PROBLEM X.

To construct a polygon, similar to a given polygon, on a given side homologous to one of the sides of the given polygon.



Let ABCDEF be the given polygon and AB' a side of the required polygon homologous to AB. Lay off AB' on AB, and from A draw all the diagonals. Draw B'C' parallel to BC to the first diagonal; then from one diagonal to

another draw sides parallel to the opposite side of the given polygon. AB'C'D'E'F' will be the required polygon. (Th. 17, Cor. 4.)

Con.—To construct a regular polygon, having one of the sides given: First construct a regular polygon of the proper number of sides; then find a fourth proportional to the side of the constructed polygon, the side of the required polygon, and the radius of the circumscribed circle of the constructed polygon; the fourth proportional will be the radius of the circumscribed circle of the required polygon.

PROBLEM XI.

To extract the square root of a quantity, or, what is the same thing, to find the side of a square equivalent to a given surface.



The surface of a square is found by squaring a side; thus, $3 \times 3 = 9$, that is, 3 in length and 3 in breadth. 9 is the surface of which we wish to find a side of a square equivalent; and, as $3 \times 3 = 9$, it is evident that 3 is the square root of 9; so also 4 of 16, 5 of 25, 6 of 36, etc.; but

when the number is large it is not so easily found.

Let us take an algebraic binomial, as $(a+b)^2 = a^2 + 2ab + b^2$, and exhibit it geometrically.

The divisors must be such as to render the quotient a root (a+b).

$$a) a^{2} + 2ab + b^{2} (a + b)$$

$$2a + b) + 2ab + b^{2}$$

$$+ 2ab + b^{2}$$

Next take a trinomial; as

$$(a+b+c)^{2} =$$
a) $a^{2} + 2ab + b^{2} + 2ac + 2bc + c^{2}$ ($a+b+c$

$$\frac{a^{2}}{2a+b} \cdot \frac{2ab+b^{2}}{2a+b^{2}}$$

$$2a+2b+c \cdot \frac{2ac+2bc+c^{2}}{2ac+2bc+c^{2}}$$

Cor. 1.—The first term of the roots is obtained the same as that of finding the root of a monomial; the divisor and root are the same, as the first surface a^2 is a square; after that we have rectangles, the breadth of which is the root, and our divisor must be the whole length of the rectangles.

Con. 2.—Each successive divisor is double the root already found, plus the next term of the root.

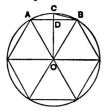
REM.—In Arithmetic we pursue the same course, except that the squares are not so entire and separate as in Algebra and Geometry; hence, in general, we take the nearest root, the largest figure of which the square is less than the given number, and we point off the figures in periods of two each, beginning at the unit's place. The reason of pointing off in periods is shown by the increase of the numbers in squares; thus,

1	11	9	99
1	11	9	99
1	$\overline{121}$	81	9801

The increase of one figure in the side makes two in the surface; it will always be this, and never more or less, as is shown by taking the smallest and the largest digits.

PROBLEM XII.

To find the circumference of a circle whose radius is unity.



With 1 as a radius describe a circumference, and inscribe in it a regular hexagon, each side of which will be unity. Take any side, as AB, and bisect it in D and its arc in C, and draw the chord CB, which will be the side of a regular polygon of double the number of sides. The triangle ODB is right-angled at D; hence,

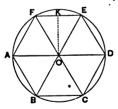
$$OD = \sqrt{\overline{OB}^2 - \overline{DB}^2} = \sqrt{1 - \frac{1}{4}} = \frac{1}{2}\sqrt{3},$$
and $CD = 1 - \frac{1}{2}\sqrt{3}$, and $CB = \sqrt{\frac{1}{4} + (1 - \frac{1}{2}\sqrt{3})^2}$.

Let C represent a side of the first polygon, and c a side of the polygon of double the number of sides; in each successive computation, after c is found, make it C in the next, and continue this process until the difference between C and c has no appreciable value; then this value of C multiplied by the number of sides will give 6.2832, which is the approximate length of the circumference when the radius is 1 and the diameter 2.

When the diameter is 1, the circumference is 3.1416, which number is represented by π ; hence, πd or $2\pi r$ represents circumference.

PROBLEM XIII.

The area of a regular polygon is equal to its perimeter multiplied by one-half the radius of the inscribed circle.



Let ABCDEF be a regular inscribed hexagonal polygon, and OK the radius of the inscribed circle. The polygon is composed of six triangles, each having a side of the polygon for its base and OK for its altitude; hence the area of the polygon is its perimeter multiplied by ½OK; that is, ¼ the radius of the inscribed circle.

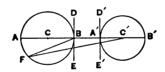
Cor.—When the number of sides of the polygon is indefinitely increased, it becomes a circle, and the radius of the inscribed circle, which has been increasing as the number of sides increased, is now the radius of the circle, and the perimeter of the polygon is the circumference of the circle; hence, the area of a circle is equal to its circumference multiplied by one-half its radius

воок V.

THEOREM I.

When the distance between the centers of two circles is greater than the sum of their radii, they are external, and the straight line joining their centers will be the shortest distance between the center of either circle and the circumference of the other; and if this line be extended to the concave arcs of both circles, it will be greater than between any two other points in the circumference.

Let C and C' be the centers of two circles external to each other; C'B is the shortest distance from C' to any point in the



circumference C; for, let the tangents DE and D'E' be drawn at B and A', they will be perpendicular to C'C; and as a perpendicular is the shortest distance from a point to a line, C'B is the shortest distance from C' to the tangent DE, and any other line from C' to the circumference is oblique to the line DE, and must go beyond it before it can reach the circumference.

2. C'A is longer than any other line drawn from C' to the circumference C, as CF. Draw the chord BF; BF is less than AB a diameter; hence,

$$C'B + BF < C'A$$

and

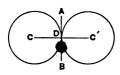
$$C'F < C'B + BF;$$

much more then is

$$C'A > C'F$$
.

THEOREM II.

When the distance between the centers is equal to the sum of the radii, they are tangents externally, and the straight line joining their centers passes through the point of tangency.



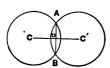
They must touch on the line joining their centers, as CD + DC' = CC'; let D be this point, and through D draw AB perpendicular to CC'; it will be a common tangent to both circles as it is perpendic-

ular to each radius at its extremity.

Or, CC' is the shortest distance between the centers, and C'D is the shortest distance from C to AB; CD is also the shortest distance from C to AB; therefore, the line between the centers of the two circles passes through their point of tangency.

THEOREM III.

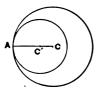
When the distance between the centers is less than the sum and greater than the difference of the radii, they intersect each other, and the line joining their centers is perpendicular to their common chord at its middle point.



CC' is the shortest distance between C and C'; hence, CD and C'D must both be perpendicular to AB at its middle point, and CC' must be a straight line.

THEOREM IV.

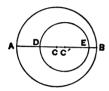
When the distance between the centers is equal to the difference of the radii, the smaller circle is tangent internally to the larger one, and the line joining their centers extended passes through the point of tangency.



C'A is the shortest distance from the center C' to the circumference C; therefore, A is the point of tangency.

THEOREM V.

When the distance between the centers is less than the difference of the radii, the smaller is wholly within the larger, and the nearest and the farthest points in the circumference of the one circle, from the center of the other circle, is in the extensions of the line joining their centers.



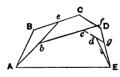
C'B is the nearest distance and C'A is the farthest in the circumference C from the center C'. (Th. 1.)

Con.—When they are concentric, their circumferences are parallel.

GEN. COR.—The line joining the centers passes through the points of tangency, the middle point of the common chord, the nearest and the farthest point of the circumference.

THEOREM VI.

If on one side of a given polygon another polygon be constructed within the given polygon, the perimeter of the interior polygon will be less than that of the given polygon.



Produce each side of the interior polygon until it meets a side of the exterior. Then Ae is less than ABe,

bf < beCf, cg < cfDg, and dE < dgE.

 \therefore AeCDE < ABCDE; Abf DE < AeCDE;

AbcgE < AbfDE; and AbcdE < AbcgE;

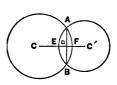
much more is AbcdE less than ABCDE.

Cor.—If from any point within a triangle lines be drawn to the extremities of either side, the sum of these lines will be less than the sum of the two other sides.

THEOREM VII.

If two circles whose radii are unequal intersect each other, the middle point of their common chord will be nearer the arc of the large circle than that of the smaller one.

Let C and C' be the centers of the two circles; then will DF be less than DE. For place the two circles so that the smaller one shall be tangent internally to the larger one.

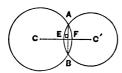




Draw AB a chord to the larger circle, A'B' will be a chord of the smaller one at the same distance from the arcs of the circles; the chord AB is longer than the chord A'B', and in order that A'B' become equal to AB it must be put nearer the center of the circle and farther from the arc; therefore, DF is less than DE.

THEOREM VIII

If the circumferences of two unequal circles intersect each other, the arc of the larger circle is less than that of the smaller one.



Let the circle C be larger than C', and let their circumferences intersect at A and B; then will the arc AFB of the larger circle be less than the arc AEB of the smaller one.

Since DF is less than DE (Th. 7), the arc AFB may be revolved on AB as an axis, the point F will fall upon ED, between D and E, and the arc AFB will be wholly within the arc AEB, and is therefore less. (Th. 6.)

REM.—An arc may be regarded as a portion of the perimeter of a polygon.

BOOK VI.

PLANES IN DIFFERENT POSITIONS.

DEFINITIONS.

- 1. A straight line is perpendicular to a plane, when it is perpendicular to every line passing through its foot in that plane.
- 2. Two planes are parallel when they are everywhere equally distant, and consequently will never meet.
- 3. Three points not in the same straight line determine the position of a plane.
- 4. The intersection of two planes is a straight line, for two planes cannot have three points common which are not in the same straight line; for, if they have, they form but one plane.
- 5. A Diedral Angle is the divergence of two planes from their common intersection, and is measured by the plane angle formed by two lines, one in each plane, perpendicular to the common intersection, at any point in this line.
- REM.—Theorems regarding several planes in different positions have no distinct principles; but special attention is required to the position of the planes, as a correct figure of two or more planes cannot be drawn upon one plane, as the blackboard.

The few theorems given on this subject are thought sufficient to illustrate this peculiarity.

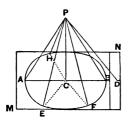
THEOREM I.

If from a point without a plane, a perpendicular be drawn to the plane and oblique lines to different points of the plane,

1st. Any oblique line will be longer than the perpendicular.

2d. Oblique lines drawn to points equally distant from the foot of the perpendicular will be equal.

3d. Oblique lines unequally distant from the foot of the perpendicular, the one farther distant will be the longer.



Let P be a point without the plane MN, PC a perpendicular to the plane, and A and B two points in the plane MN equally distant from C the foot of the perpendicular; and D a point farther distant from C than A and B.

1st. Let all the points A, C, B, and D be in the same straight line. Suppose a

plane passed through them and the point P; then will all the lines PA, PC, PB, and PD be in the plane PAD; and AD, the line of intersection of the two planes, will be a base line for the figure ADP. Since PC is perpendicular to the plane MN, it is perpendicular to AD. (Def. 1.) PA and PB are oblique lines drawn from P to points equally distant from the foot of PC; hence, PA = PB. (Bk. 2, Th. 6, part 2.) And as D is farther distant from C, PD is longer than PA or PB. (Part 3, same Prop.)

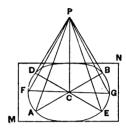
2d. Other oblique lines, as PE, PF, and PH, may be drawn to different points of MN, at the same distance from C as A and B, and the planes PCE, PCF, and PCH passed; the triangles PCE, PCF, and PCH will be right-angled triangles, equal to PCA and PCD; hence, PE = PF = PA = PB.

REM.—If a circumference be drawn with C as a center and a radius equal to CA, it will pass through all the points A, E, F, B, and H, and the point D will be without the circumference.

THEOREM II.

A line which is perpendicular to two lines of a plane, at their intersection, is perpendicular to any other line of the plane passing through this intersection and therefore perpendicular to the plane.

Let PC be perpendicular to AB and DE at C, the point of intersection of the two lines in the plane MN. With C as a center and any radius describe a circumference cutting the two lines in A, B, D, and E, and draw PA, PB, PD, and PE. Through C draw any other line as FG, terminating in the circumference. PC will also be perpendicular to FG; as F and



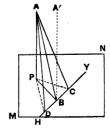
G are equally distant from C, PF is equal to PG; hence the line PC has two points P and C equally distant from F and G, the extremities of the line FG; hence PC is perpendicular to FG, any line of the plane MN, and is therefore perpendicular to every line in the plane; consequently perpendicular to the plane. (Def. 1.)

COR.—The two sides of an angle, two parallel lines, or three points not in the same straight line, determine the position of a plane.

THEOREM III.

If from the foot of a perpendicular to a plane a line be drawn at right angles to any line of that plane, and the point of intersection of these two lines be joined with any point in the perpendicular, the last line will be perpendicular to the line in the plane to which the line was drawn at right angles.

From P, the foot of the perpendicular AP, draw PB perpendicular to HY, any line in the plane MN. Make BC and BD equal, and draw PC and PD, which will also be equal; and then draw AC and AD, which will also be equal. (Bk. 2, Prob. 6, part 2.) And since AB has two points, A and B, equally distant from D and C, AB is perpendicular to DC. (Bk. 1, Th. 9.)

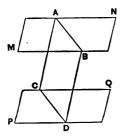


Cor. 1.—Since BA is perpendicular to DC, when drawn from any point in the line PA or PA produced indefinitely; and as in every position BA lies in the plane APB, it is also perpendicular to DC when it becomes parallel to PA and is also perpendicular to PB, and hence perpendicular to the plane MN; consequently, if one of two parallels is perpendicular to a plane, the other is also perpendicular to the same plane.

COR. 2.—Two lines perpendicular to the same plane are parallel.

THEOREM IV.

If two parallel planes are intersected by a third plane, the lines of intersection will be parallel.



Let the parallel planes MN and PQ be intersected by the plane ABCD; then will the lines of intersection AB and CD be parallel.

Make AB and CB of the same length, and draw AC and BD; the line AB lies in the plane MN, and CD in the plane PQ; as the planes are parallel, they will never meet; hence, AB and CD will never meet;

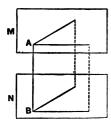
but AB and CD also lie in the same plane ABCD, and are therefore parallel.

COR. 1.—The figure ABCD is a parallelogram.

COR. 2.—Parallel lines intercepted between parallel planes are parallel. REM.—A plane may always be made to pass through parallel lines, as all parallels have the same direction.

THEOREM V.

If in parallel planes, angles are formed whose sides respectively take the same direction, the angles will be equal.



In the planes M and N, let A and B be angles whose sides respectively take the same direction. Since the sides of the angles respectively take the same direction, if the one angle is placed on the other, they will coincide, and consequently are equal.

Cor. 1.—If the vertices A and B are joined by a straight line, and planes passed through this

line and the corresponding sides of the two angles, a diedral angle will be formed.

Cor. 2.—If a diedral angle is cut by parallel planes, the plane angles formed are equal.

BOOK VII.

DEFINITIONS.

1. A Prism is a solid, two of whose faces are equal parallel polygons, which are termed the lower and upper bases, whilst the other faces are parallelograms which form the convex surface.

Rem.—The bases may be polygons of any number of sides.

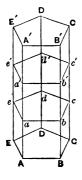
- 2. A Right Prism has its lateral edges perpendicular to its bases.
- 3. An Oblique Prism has its lateral edges oblique to its bases.
- 4. The Altitude of a prism is the perpendicular distance between its bases.
- 5. A Regular Prism is a right prism having regular polygons for its bases.
- 6. A Parallelopipedon is a prism having its bases and its faces parallelograms, the opposite faces necessarily equal.
- 7. If the bases and faces are rectangles, it is called a Rectangular Parallelopipedon.
 - 8. If they are all equal squares, it is a Cube.

REM.—A solid is said to have three dimensions, to which special attention must be given; thus, the dimensions of a rectangular parallelopipedon are the length and the perpendicular breadth of the base, regarding it as a plane figure, and the perpendicular distance between the two bases.

In a prism of any shape, the dimensions of the base are the same as those of a plane figure, and the altitude is the perpendicular distance between the bases.

THEOREM I.

The sections formed by parallel planes cutting a prism, are equal polygons.



Let abcde and a'b'c'd'e' be sections formed by parallel planes cutting the prism; ab and a'b' are parallel, being the intersection of parallel planes with a third plane (Book 6, Th. 4); and they are equal, as they are parallels between two other parallels; so also for the same reasons are bc = b'c', cd = c'd', etc.; and since the angles are formed by parallel planes cutting diedral angles, they are respectively equal (Bk. 6, Th. 5, Cor. 2); hence, the sections are equal polygons.

Cor.—If the sections are parallel to the bases, then will they be equal polygons.

THEOREM II.

The lateral surface of a right prism is equal to the product of its perimeter and altitude.

As each face is a rectangle, its surface is equal to the product of its base and altitude; hence, the lateral surface of the prism is the product of the sum of the sides of the base and the common altitude; but the sum of the sides of the base is the perimeter; hence, the lateral surface of a prism is the product of its perimeter and altitude.

Cor. 1.—If the prism be oblique, its faces will be parallelograms instead of rectangles, and is measured accordingly.

Cor. 2.—The convex surface of a cylinder is equal to the product of the circumference of its base and altitude. For a prism having a regular polygon for its base becomes a cylinder, by increasing the number of sides indefinitely, and the perimeter of the polygon, forming its base, becomes the circumference of the base of the cylinder.

Cor. 3. Convex surface of a cylinder = $4\pi R^2$, Surface of the two bases = $2\pi R^2$, Entire surface of the cylinder = $6\pi R^2$.

THEOREM III.

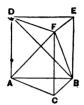
The volume of a rectangular parallelopipedon is equal to the product of its three dimensions.

The area of the rectangular base is the product of its two dimensions, and for every unit in altitude there will be as many solid units as there are square units in the base; hence, the volume is equal to the product of the three dimensions.

- Cor. 1.—A rectangular parallelopipedon can be divided into two equal triangular prisms; and the volume of each is equal to the area of the base multiplied by the altitude.
- Cor. 2.—The volume of any right prism is equal to the area of its base multiplied by its altitude; as any prism may be divided into triangular prisms.
- Cor. 3.—A right prism having for its base a regular polygon, if the number of sides of the polygon be indefinitely increased, it becomes a cylinder; hence the volume of a cylinder is equal to the area of the base multiplied by its altitude.
- Cor. 4.—An oblique prism is measured in the same way; as the area of a rectangle and a parallelogram of the same dimensions is equal; so also is the volume of the oblique prism equal to that of the right prism of the same dimensions.
- Scho. 1.—The above results are true if one or more of the dimensions are fractional, as the common denominator of the fractions will be the denomination of the unit of measure.
- Scho. 2.—If the dimensions are incommensurable, the unit of measure will be an infinitesimal.

THEOREM IV.

A triangular prism may be divided into three equivalent pyramids.



1st. Let ABCDEF be a triangular prism. Pass a plane through the three points, A, B, and F, cutting off the pyramid ABC-F, having the triangle ABC for its base, and the altitude of the prism for its altitude.

2d. Pass a plane through BFD, cutting off the pyramid DEF-B, the upper base for its base, and

having the altitude of the prism for its altitude; hence it has the same dimensions as the first pyramid, and is consequently equal to it.

3d. Take away the first pyramid and place the two remaining upon ABDE as a base; their vertices will be in F, and hence will have the same altitude; their bases are equal, as each is the half of the parallelogram ABED, as the diagonal BD divides it into equal parts.

And as the first and second are equal, and also the second and third, it follows that the first and third are equal; hence they are all equal.

Cor.—The volume of a triangular pyramid is equal to the area of its base, multiplied by one-third its altitude.

THEOREM V.

The volume of the frustum of a triangular pyramid is equivalent to that of three pyramids, two of which shall have fortheir altitudes the altitude of the frustum, and for their bases respectively the lower and upper bases of the frustum, and the third pyramid shall be a mean proportional between the other two.



Let ABCDEF be the frustum of a pyramid.

1st. Pass a plane through ABF, cutting off a pyramid, having the lower base of the frustum for its base, and the altitude of the frustum for its altitude. Designate it P.

2d. Draw the diagonal DB and pass a plane through DBF, cutting off a pyramid, having for its base the upper base of the frustum, and for its altitude the altitude of the frustum. Designate this pyramid P'.

Take away the pyramid P and place the remnant on ABED for its base, and being cut by the plane DBF, forms two pyramids, having their vertices in F; hence they have the same altitude; the one P' has DEB for its base; and the third, which designate p, has for its base ABD.

Since P and P' have the same altitudes, they are in proportion to their bases; and as their bases are similar triangles, which are proportional to the squares of their homologous sides, AB and DE are homologous sides; let

$$S = AB,$$
and $s = DE,$
then $P: P':: S^2: s^2;$ (1)

p and P' have the same altitude; hence they are in proportion to the areas of their bases, ABD and DEB, which triangles have the same altitude, and are therefore proportional to their bases, S and s; hence,

$$p:\mathsf{P}'::\mathsf{S}:s; \tag{2}$$

squaring the proportion,

$$p^2: P'^2:: S^2: s^2;$$
 (3)

.. (1) and (3) have an equal ratio; hence,

$$P : P' :: p^2 : P'^2$$

Multiplying the extremes and means,

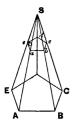
$$P \times P'^2 = P' \times p^2;$$

and dividing by P', $P \times P' = p^2$;

that is, the third pyramid is a mean proportional between the other two.

THEOREM VI.

The convex surface of a right pyramid is equal to the product of the perimeter of its base and one-half its slant height.



The base of the right pyramid ABCDE is a regular polygon. A perpendicular from the vertex S would fall upon the center of the polygon. The faces will all be equal isosceles triangles; and the surface of each is the product of its base and one-half its altitude; the altitude of each triangle is the slant height of the pyramid; consequently, the entire convex surface is the perimeter of the base multiplied by one-half the slant height.

Con. 1.—If the number of sides of the regular polygon of the base be indefinitely increased, the polygon becomes a circle, and the pyramid a cone; hence the convex surface of a cone is one-half the product of the circumference of the base and the slant height.

Con. 2.—If a plane abcde cut the pyramid or cone parallel to the base, then the portion between the parallel bases will be a frustum of a pyramid or cone. The sides of the frustum are all trapezoids, each of which is measured by the product of one-half the sum of the parallel bases and altitude; hence, the convex surface of the entire frustum is one-half the product of the sum of the two perimeters and the slant height.

Cor. 3.—The volume of the frustum of a cone is equal to that of three cones, two having for their altitude the altitude of the frustum, and for their bases respectively the lower and upper bases of the frustum, and the third cone a mean proportional between the other two.

BOOK VIII.

DEFINITIONS.

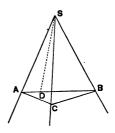
- 1. A Polyedral Angle is the divergence of three or more planes from the point formed by their common intersection.
- 2. An angle formed by three planes is called a Triedral Angle.
- 3. The plane angles which form a triedral angle are called Facial Angles.
- 4. A Sphere is a solid every point of whose surface is equally distant from a point within called the centre.
- 5. The distance from the center to the surface is the Radius of the sphere.

THEOREM I.

The sum of any two of the plane angles which form a triedral angle is greater than the third angle.

Let the plane angle ASB be greater than either of the other angles which form the triedral angle S.

In the plane ASB draw AB, making SA = SB, and on the plane angle ASB place the angle BSC; SB on SB, and SC will take the direction of SD, and make SC=SD; then as AB < AC+BC, and BC = BD, and taking BC = BD from each side, AD < AC.

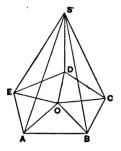


The two triangles ASC and ASD have two sides respectively equal and the third side AC > AD; hence the angle ASC > ASD; therefore the sum of the two plane angles BSC and ASC is greater than the third angle ASB.

4

THEOREM II.

The sum of all the angles which form a polyedral angle is less than four right angles.



Let S be the vertex of a polyedral angle, and pass a plane cutting the planes and forming the polygon ABCDE.

From any point as O within the polygon, draw lines to the extremities of all its sides; there will be as many triangles as faces forming the polyedral angle.

At each vertex of the polygon there is a triedral angle, formed by one plane angle of the polygon and two in the faces of the

polyedral angle S; the one angle in the polygon is less than the sum of the two others (Th. 1); but as the number of the triangles in the polygon is the same as of the plane angles forming the polyedral angle S, hence the sum of all the angles of the triangles in the polygon is equal to the sum of all the angles of the triangles forming the polyedral angle S.

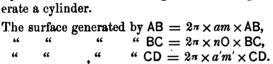
And as the sums of all the angles of the polygon are less than the sums of all the angles on the faces at the points A, B, C, etc., at which triedral angles are formed, on the faces there are two angles at each vertex, whilst in the polygon there is but one, the remaining angles of the triangles of the polygon must be greater than the sum of the angles forming the polyedral angle at S. The sum of all the angles at O is four right angles; hence the sum of all the plane angles forming the polyedral angle S is less than four right angles.

THEOREM III.

The surface generated by the revolution of a regular semi-polygon about the diameter of the circumscribed circle as an axis, is equal to the circumference of the inscribed circle multiplied by this axis.

Let ABCD be one-half of a regular polygon, which being revolved about AD the diameter of the circumscribed circle, as an axis, the surface generated by the perimeter is $2\pi \times Oa \times AD$.

The triangles ABb and CDc will generate equal cones, and the rectangle BbCc will generate a cylinder.



The triangles Oam and ABb are similar; consequently,

AB : Oa :: Ab :
$$am$$
; \therefore AB $\times am = Oa \times Ab$;
hence also, $a'm' \times CC = Oa' \times cD$.

Surface generated by AB =
$$2\pi \times Oa \times Ab$$
,
" " BC = $2\pi \times On \times bc$,
" " CD = $2\pi \times Oa' \times cD$.

Oa = On = Oa', each equal to the radius of the inscribed circle. By addition, Whole surface $= 2\pi \times Oa \times AD$.

Cor. 1.—When the number of the sides of the semi-polygon is indefinitely increased, it becomes a semicircle; the radius of the inscribed circle becomes equal to that of the circumscribed, and the figure generated a sphere; and its surface $= 2\pi \times r \times 2r = 4\pi r^2$; that is,

The surface of a sphere is equal to the circumference of a great circle multiplied by the diameter.

Cor. 2.—The surfaces of spheres are to each other as the squares of their radii; for, let R and R' be the radii of two spheres, their surfaces will be $4\pi R^2$ and $4\pi R'^2$; hence,

$$4\pi R^2 : 4\pi R^2 :: R^2 : R^2$$

THEOREM IV.

The volume of a sphere is equal to the product of its surface and one-third of its radius.

Take a cube, each side say 2 inches, and suppose a sphere inscribed. Consider each face as the base of a pyramid whose vertex is in the center of the inscribed sphere, whose radius is one inch, which is also the altitude of each pyramid.

The volume of each pyramid is equal to the product of its base, and one-third of its altitude; and, the volume of all the pyramids, which equals that of the cube, is the whole surface of the cube multiplied by one-third the radius of the inscribed sphere.

The cube has eight triedral angles; let each of these be cut by a plane tangent to the inscribed sphere, and perpendicular to a straight line drawn from the center of the sphere to the vertex of each triedral angle; thus, a new set of pyramids will be formed, each having the same altitude as the former; the number of bases will be increased, and the sum of all the bases will be the surface of the solid figure remaining.

Continue to pass planes indefinitely, tangents to the inscribed sphere, until the surface of the figure becomes the surface of a sphere, and its volume will be the surface of the sphere multiplied by one-third of the radius; that is,

> Volume of sphere $= 4\pi R^2 \times \frac{1}{3}R = \frac{4}{3}\pi R^3$; Volume of cylinder $= \pi R^2 \times 2R = 2\pi R^3$;

hence, Sur. of sphere: Sur. of cylinder:: 4:6::2:3.

Vol. of sphere: Vol. of cylinder:: $\frac{4}{3}$: 2:: 4:6:: 2:3;

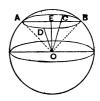
.. Sur. sphere: sur. cylinder:: vol. sphere: vol. cylinder.

REM.—When a plane touches a sphere at but one point, it is tangent to the sphere, and the plane is perpendicular to the radius drawn to this point.

THEOREM V.

Every section of a sphere made by a plane is a circle.

Let ACBD be a section of a sphere whose center is O; draw OE perpendicular to the section; OA, OB, OC, and OD, and any other line from O to the intersection of the plane and the surface of the sphere, will all be equal, as they are radii of the sphere; and as OE is perpendicular to the section, it will pass



through the middle point of AB or any other line passing through E and terminating in the surface of the sphere; hence, ACBD is a circle and E is its center.

REM.—If the plane pass through the center of the sphere, the circle formed will be a great circle; if it do not pass through the center it will form a small circle.

Cor. 1.—A line drawn from the center of a sphere perpendicular to a small circle passes through its center, or a line perpendicular to a small circle at its center passes through the center of the sphere, and its extremities are poles of the small circle and of every circle whose plane is parallel to that of the small circle.

Cor. 2.—The pole of a circle is equally distant from every point in the circumference; in the case of the great circle both poles are equally distant, each being a quadrant's distant; in the case of the small circle, the one is greater the other less distant than a quadrant.

Cor. 3.—The farther from the center the less the circle.

THEOREM VI.

A great circle divides the sphere into two equal parts.

The plane of the great circle passes through the center of the sphere, and divides it into two parts, each of which has the great circle for its base, and every point of the convex surface of each part is equally distant from the center of their common bases; hence, the two parts must coincide and consequently are equal.

REM.—Each part is called a hemisphere.

THEOREM VII.

The intersection of two great circles is a diameter of the sphere.

The intersection of two planes is a straight line, and as each plane of a great circle passes through the center of the sphere, the center is one point of their intersection; hence their intersection is a straight line passing through the center of the sphere. This straight line is a diameter.

- Cor.—The intersection of the circumferences on the surface of the sphere will be the extremities of the diameter, 180° distant; hence they bisect each other.
- DEF. 1.—The portion of the surface of a sphere included between two semi-circumferences of great circles is called a Lune.
- Def. 2.—A **Spherical Polygon** is a portion of the surface of a sphere bounded by three or more arcs of great circles. The arcs form the sides of the polygon, each of which is less than a semi-circumference.

REM.—The sides of a spherical polygon correspond to the facial angles of the polyedral made at the center of the sphere by the planes of the sides of the polygon, and the angles of the polygon correspond to the diedrals of the same polyedral angle.

THEOREM VIII.

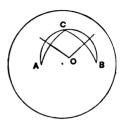
The shortest distance between any two points on the surface of a sphere is traced on the arc of a great circle.

The truth of this theorem is evident from Th. 8, Bk. 5. For, when two unequal circumferences intersect on the surface of a sphere, the intercepted arcs hold the same position in regard to each other; as, when a large and a smaller circle intersect on the same plane; from which it is evident that the intercepted arc of the greater circle is less than that of the smaller; and, as on a sphere the circumference of a great circle is the largest that can be described upon it, hence the shortest distance between any two points on the surface of a sphere must be traced on it.

PROBLEM I.

To pass a small circle through any three points on the surface of a sphere, not in the circumference of a great circle.

Let A, B, and C be the three points. Join A and C, and B and C by arcs of great circles. Pass arcs of great circles perpendicularly through the middle points of AC and CB, as in Plane Geometry, and their intersection O will be the pole of a small circle, from which, with the distance between the points of the dividers equal to

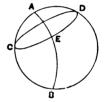


OA, describe the small circle, which will pass through A, C, and B.

PROBLEM II

To pass a great circle through any two points on the surface of a sphere.

Let A and B be any two points on the surface of a sphere. Make either point, as A, a pole, and from it describe a circumference of either a small or a great circle; and from the other point, as B, pass the arc of a great circle cutting the circumference CD at right angles; it will pass through the point A. The



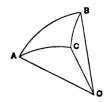
pole of the great circle must be taken at a quadrant's distance from B and from E.

REM.—The point on the circumference of the circle through which the arc of a great circle passes, is found by Prob. 2, Book I, and from the pole of this point and B, a quadrant's distance from each, the arc is drawn.

THEOREM IX.

In every spherical triangle, the sum of any two sides is greater than the third side.

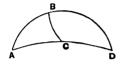
Let ABC be a spherical triangle; then will AC+BC > AB. Join the vertices A, B, and C, with O, the center of the sphere, and a triedral angle is formed, the arcs of whose facial angles are the sides of the spherical triangle; but (Th. 1) "the sum of any two of the plane angles which form a triedral



angle is greater than a third; hence, the sum of any two sides of a spherical triangle is greater than the third side.

THEOREM X.

The sum of the three sides of a spherical triangle is less than the circumference of a great circle.



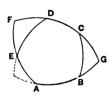
Let ABC be a spherical triangle. Produce AB and AC until they meet in D. The arcs ABD and ACD are semi-circumferences, since two great circles always bisect each other.

In the triangle BCD, the sum of the two sides CD and BD is greater than the third side BC; hence the sum of the three sides AB, AC, and BC is less than the circumference of a great circle.

REM.—The sides of a spherical triangle are arcs which correspond with and measure the facial angles of a triedral angle, the vertex of which is at the center of the sphere.

THEOREM XI.

The sum of all the sides of a spherical polygon is less than the circumference of a great circle.



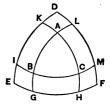
Let ABCDE be a spherical polygon. Produce AB and DC until they meet in G; also produce AE and CD until they meet in F. BC is less than BG+CG, and DE is less than EF+FD; hence the sum of the sides of the polygon is less than the sum of the sides of the triangle AFG; and the sum

of the sides of the triangle is less than the circumference of a great circle (Th. 10); much more then is the sum of all the sides of the polygon less than the circumference of a great circle.

THEOREM XII.

If from the vertices of the angles of a spherical triangle as poles, with a distance between the points of the dividers equal to a quadrant, arcs be drawn forming another spherical triangle, the vertices of this triangle will be respectively the poles of the sides of the first triangle.

Let ABC be a spherical triangle, and then with each vertex as a center and a distance between the points of the dividers equal to ninety degrees, describe the polar triangle DEF. First with A as a pole describe the arc EF, with B as a pole describe DF, and with C as a pole describe DE; in each case the distance

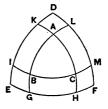


between the points of the dividers being 90 degrees. Since $AE = 90^{\circ}$ and $CE = 90^{\circ}$, E is the pole of AC; and since $BD = 90^{\circ}$ and $DC = 90^{\circ}$, D is the pole of BC; and as $BF = 90^{\circ}$ and $AF = 90^{\circ}$, F is the pole of AB.

THEOREM XIII.

Any angle in one of two polar triangles is measured by a semi-circumference minus the side opposite of the other triangle.

Let ABC and DEF be triangles polar to each other; produce the sides of ABC until they meet those of DEF; A is the pole of the arc GH by which the angle A is measured, E is the pole of KH, and F is the pole of LG; hence, EH = 90° and FG = 90°; hence, GH = 180°—EF; that is, the angle A is measured by a semi-circumference



minus the side opposite in its polar triangle; so also in regard to each of the other angles.

Cor. to 10th and 13th Th.—The sum of the three angles of a spherical triangle is less than six right angles and greater than two.

Cor. 2.—A spherical triangle may have two or even three right angles, or as many obtuse angles; when it has three right angles it is called the trirectangular triangle, whose surface is equal to one-eighth the surface of the sphere.

Con. 3.—The sum of the three angles of a spherical triangle is not a constant quantity, but varies between two and six right angles, never reaching either of these limits.

REM.—The excess of the sum of the angles of a spherical triangle over two right angles is called the spherical excess.

THEOREM XIV.

A lune is to the surface of a sphere as the arc which measures its angle is to the circumference of a great circle.

Surface of lune: 8 trirectangular tri.:: angle A: 4;

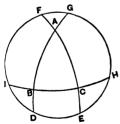
 \therefore 4L = A × 8T, and L = A × 2T.

Cor.—The surface of a lune is equal to its angle multiplied by twice the trirectangular triangle.

REM.—As the right angle is the unit, the angle will be indicated by a fraction; as \$\frac{43}{6}\$, which is 43 degrees.

THEOREM XV.

The area of a spherical triangle is equal to its spherical excess multiplied by the trirectangular triangle.



Let ABC be the spherical triangle.

The triangles ADE and AFG form a lune = angle $A \times 2T$;

the triangles BGH and BID form a lune = angle $B \times 2T$;

the triangles CFI and CEH form a lune = angle $C \times 2T$.

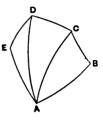
By addition we get 2 (A + B + C) T = 2 area of ABC + 4T,and $(A + B + C) T \stackrel{.}{=} \text{ area ABC} + 2T,$ and (A + B + C) T - 2T = area ABC. A rea ABC = (A + B + C - 2) T.

THEOREM XVI.

The area of a spherical polygon is equal to its spherical excess multiplied by the trirectangular triangle.

Joining A and C and A and D by arcs of great circles, we divide the polygon into triangles.

The sum of all the angles of the triangles is equal to the sum of all the angles of the polygon; hence, the area of the polygon is equal to the sum of the areas of the triangles.



Let

S = Sum of all the angles,

and

n =Number of the sides of the polygon,

(n-2) = "triangles.

Area of polygon = [S - (n-2) 2] T;

Area of ABCDE = (S - 2n + 4) T.

APPLICATION OF LOGARITHMS.

A Logarithm is the exponent or power of some number, which is called the base of the logarithms.

The base of the logarithms in common use is 10; hence,

$$10^0 = \frac{18}{18} = 1$$
; therefore, the logarithm of 1 is 0.
 $10^1 = 10$; """10 "1.
 $10^2 = 100$; """100 "2.
 $10^3 = 1000$; """1000 "3.

The integral number of the logarithm is called the Characteristic, and when positive is one less than the number of integral figures in the number of which it is the logarithm.

The logarithm of any number between 1 and 10 must be between 0 and 1; the logarithm of any number between 10 and 100 must be between 1 and 2; that is, the logarithm of any number between 1 and 10 is a fraction, and the logarithm of any number between 10 and 100 is 1 + a fraction.

The calculations of the fractions is made by an algebraic process, and logarithmic tables are formed to facilitate trigonometrical computations. Observe also that

.1 =
$$\frac{1}{10}$$
 = 10⁻¹; that is, the logarithm of .1 is -1;
and .01 = $\frac{1}{10^2}$ = 10⁻²; """ " " " .01 " -2.
.001 = $\frac{1}{10^3}$ = 10⁻⁸; "" " " " " .001 " -3.

REM.—The characteristic of the logarithm of a fraction is negative and corresponds to the number of decimals; hence, the logarithm of any number between 1 and .1 is between 0 and -1, and is put -1 + a fraction.

As logarithms are exponents, they can only be used as such; that is, for Multiplication and Division, for Involution and Evolution; thus, $a^1 \times a^1 = a^2$; $a^2 \times a^3 = a^5$; $a^1 \times b^2 = ab^2$; $a^2 \times b^2 = a^2b^2$; $a^1 \times a^1 \times a^1 = a^3$; $a^3 \div a^2 = a^1$; $\sqrt{a^2} \times \sqrt{a} = \sqrt{a^3} = a^{\frac{3}{2}}$; $\sqrt{a^2b} = ab^{\frac{1}{2}}$; $\sqrt{a^2b^3c^5} = ab^{\frac{3}{2}}c^{\frac{5}{2}}$; $a^2b^3c^4d^5 \div ab^4c^3d^6e^2 = ab^{-1}cd^{-1}e^{-2}$.

REM.—Multiplication is performed by adding the exponents of the multiplier and multiplicand; Division by subtracting the exponents of the divisor from those of the dividend; Involution by multiplying the exponent by the exponent of the power to which it is to be raised; and Evolution by dividing the exponents by the index of the root.

From the table of logarithms the decimal parts are found, and the characteristic must be added. The characteristic of an integral number will always be one less than the number of integral figures.

The	logarithm	\mathbf{of}	4532	is	3.656290
"	"	"	453.2	"	2.656290
"	"	"	45.32	"	1.656290
66	"	"	4.532	"	0.656290
"	"	"	.4532	66	$\bar{1}.656290$
"	66	"	.04532	"	$\bar{2}.656290$

To find the logarithm of a number of three or less figures, find the given number in the first column of the table, and take the logarithm under zero; if there be four figures, reserve the one in the units' place and find the other three in the first column, and take the logarithm under the figure corresponding to the reserved figure.

The	logarithm	\mathbf{of}	4530	is	3. 656098
66	. "	"	45300	"	4.656098
66	66	66	453000	66	5.656098

To find the logarithm of a number which has more than four figures:

First find the logarithm of the number expressed by the four left-hand figures; then multiply the common difference given in the table by all the figures left, and of this product reject as many figures on the right as there were reserved figures, and add the balance to the logarithm already found.

Thus, find the logarithm of 564236.

The characteristic is 5.

The decimal part of the logarithm of 5642 is	.751433
Common difference, $77 \times 36 = 27$) 72	28
	.751461

As the figures cut off are more than .5, we add 28 instead of 27. To which add the characteristic and the

logarithm of 564236 = 5.751461.

To find the number corresponding to the given logarithm:

If the given logarithm be in the table, take the three figures opposite in the first column and the one immediately over it at the top of the page, and point off one more integral figure than there are in the characteristic of the logarithm.

But if the given logarithm is not in the table, take the number corresponding to the next less logarithm; then divide the difference between this logarithm and the given one by the tabular difference, annexing ciphers to the dividend, and then affixing this quotient to the number already found. The figure occupying the tenths' place must take the first place after the number already taken from the table; this will sometimes be 0.

EXAMPLES.

1. Find the product of 4573 and 6321.

logarithm 4573 =	3.660201		
logarithm 6321 =	3.800786		
Next less number (2890),	$\overline{7.460987}$		
Next less logarithm,	898		
Difference,	89		
Com. diff., 150.	150) 890 (5933		

Hence, number corresponding, 28905933.

2. Divide 1728 by 12.

$$\begin{array}{lll} \text{logarithm 1728} = & & 3.237544 \\ \text{logarithm } & 12 = & & \frac{1.079181}{2.158363} \end{array}$$

Number corresponding, 144.

There will be slight inaccuracies, as the logarithms are only carried to six places of decimals.

3. Find the logarithmic sine of 37° 15′ 25″.

$$\sin 37^{\circ} 15' = 9.781966$$

 $\sin 25'' \text{ (diff. } 2.77 \times 25 = 69.25) = 69$
 $\sin 37^{\circ} 15' 25'' = 9.782035$

4. Find the tangent of 57° 30′ 30″.

tang 57° 30′ = 10.195813
tang 30″
$$(4.65 \times 30 = 139.50) = 139$$

tang 57° 30′ 30″ = 10.195952

I will not add any more examples, as the learner will soon become familiar with the use of the tables.

TRIGONOMETRY.

Trigonometry treats of the methods of finding the unknown parts of a triangle, when certain parts are known.

Every triangle has six parts, viz., three sides and three angles. When three of these are known, one at least being a side, the other three can be found by these methods.

Plane Trigonometry treats of plane triangles.

When one thing depends upon another for its value, the first is said to be a function of the second.

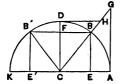
Sines, tangents, cosines, cotangents, etc., are functions of arcs or angles.

DEFINITIONS.

- 1. The Sine of an angle or arc is a line drawn from the end of the arc perpendicular to the radius drawn from the beginning of the arc to its center, or to the vertex of the angle.
- 2. The Versed Sine is the distance from the foot of the sine to the beginning of the arc.
- 3. The Cosine is the sine of the complement of the angle; it is equal to the radius minus the versed sine.
- 4. The **Tangent** is a line drawn from the beginning of the arc perpendicular to the radius at its extremity, and is limited by a line drawn from the vertex of the angle through the point at the end of the arc.
- 5. The line joining the vertex of the angle and the extremity of the tangent is called the **Secant**.
- 6. The Cotangent is the tangent of the complement of the angle.



The functions of an angle are exhibited in the following diagram:



BE is the sine of the acute angle ACB, and the cosine of BCD, its complement.

BF or CE is the cosine of the acute angle ACB, and the sine of BCD, its complement.

AG is the tangent of the acute angle ACB, and the cotangent of BCD, its complement.

DH is the cotangent of the acute angle ACB, and the tangent of BCD, its complement.

The radius DC is the sine of the right angle ACD; its cosine is zero; the tangent would be AG extended until it meet CD extended; but they are parallel; hence the tangent of 90° is infinite, and the cotangent zero.

If the angle is obtuse, as ACB', its sine is B'E', the same as of B'CK, its supplement. All the other functions, except the versed sine of the obtuse angle, will be the same length as of the acute angle, its supplement.

All the functions of acute or right angles or arcs terminating in the first quadrant have plus signs. If the angle is obtuse, its cosine, tangent, and cotangent will have a minus sign.

Cor. 1.—The sine of an angle cannot be greater than the radius; but the tangent may have any value whatever.

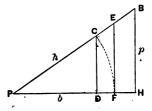
Cor. 2.—It is needless to say that the cosine becomes equal to the radius, or the cotangent infinite, as this only happens when there is no angle.

PROBLEM I.

To show the relations of the sines, cosines, tangents, and cotangents of the angles of a right-angled triangle with the sides of the triangle,

Let PHB be a triangle, rightangled at H; PF or PC is the radius of the arc CF; DC is the sine of the angle BPH, PD its cosine, and FE its tangent and cotangent of HBP, its complement.

The triangles PDC and PHB are similar; hence the proportions,



that is,
sine P:
$$p$$
:: R: h ; (1)

$$\therefore p = \frac{\sin e P \times h}{R}$$
, (1)
and $h = \frac{p \times R}{\sin P}$, (2)
and sine P = $\frac{p \times R}{h}$ (3)

$$= \cos e B$$
, (3)
and PD: PH:: PC: PB;
that is,
sine B: b :: R: h ; (2)

$$\therefore b = \frac{\sin e B \times h}{R}$$
, (1)
and $h = \frac{b \times R}{\sin B}$, (2)
sine B = $\frac{b \times R}{h}$

$$= \cos e B$$
, (3)

and from 2 and 2,

$$\frac{p \times R}{\sin P} = \frac{b \times R}{\sin B}, \text{ and } \frac{p}{\sin P} = \frac{b}{\sin B};$$

$$\therefore \sin P : \sin B :: p : b. \tag{4}$$

Alternating 1st and 2d proportions,

$$\sin P : R :: p : h$$
, and $\sin B : R :: b : h$. (4)

The triangles PFE and PHB are similar; hence the proportion,

$$\mathsf{EF}:\mathsf{BH}\,::\;\mathsf{PF}:\mathsf{PH};\;\mathsf{that}\;\mathsf{is},\;\mathsf{tang}\;\mathsf{P}:p\;::\;\mathsf{R}:b;$$

hence,
$$p = \frac{\tan g \ P \times b}{R}$$
, and $b = \frac{\tan g \ B \times p}{R}$, by analogy. (5)

Tang P =
$$\frac{p \times R}{b}$$
 = cot B, and tang B = $\frac{b \times R}{p}$ = cot P, an., (6)

and
$$p = \frac{R \times b}{\tan g}$$
, and $b = \frac{R \times p}{\tan g}$. (5)

REM.—In a right-angled triangle, either acute angle is a complement of the other; hence, the sine of the one is the cosine of the other, and the tangent of the one is the cotangent of the other.

As these formulas are general principles of right-angled triangles; they must be fixed indelibly on the mind of the student.

REM.—The small letters represent the sides opposite the angles having corresponding large letters.

FORMULAS.

- · 1. Either side is equal to the sine of the opposite angle multiplied by the hypothenuse and divided by the radius.
- 2. The hypothenuse is equal to the radius multiplied by either side, and divided by the sine of the angle opposite this side.
- 3. The sine of either acute angle is equal to the opposite side multiplied by the radius and divided by the hypothenuse.
- 4. Either side, including the hypothenuse, is to any other side as the sine of the angle opposite the former side is to the sine of the angle opposite the latter side.
- 5. Either side is equal to the tangent of its opposite angle multiplied by the other side and divided by the radius; or,

Either side is equal to the radius multiplied by the other side and divided by the tangent of the angle opposite this other side.

6. The tangent of either acute angle is equal to its opposite side, multiplied by the radius and divided by the other side.

EXAMPLES.

1. Given
$$h = 43$$
, $B = 25^{\circ}$, to find p , b , and P .
$$P = 90^{\circ} - 25^{\circ} = 65^{\circ}.$$
Formula 1, $p = \frac{\sin P \times h}{R}$; $\therefore \log p = \log \sin 65^{\circ} + \log 43 - \log R$,
$$\log \sin 65^{\circ} = 9.957276$$

$$\log 43 - 10 = 1.633468$$

$$p = 38.971, \text{ No. corres.} \quad 1.590744$$
Formula 1, $b = \frac{\sin B \times h}{R}$; $\therefore \log b = \log \sin 25^{\circ} + \log 43 - \log R$,
$$\log \sin 25^{\circ} = 9.625948$$

$$\log 43 - 10 = 1.633468$$

$$b = 18.172, \text{ No. corres. to log,} \quad 1.259416$$

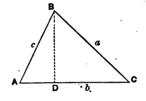
2. Given
$$h = 624$$
, $P = 48^{\circ}$, to find p , b , and B . $B = 42^{\circ}$, $p = 463.723$, and $b = 417.538$, Ans.

- 3. Given b = 535, $B = 65^{\circ} 15'$, to find P, p, and h. $P = 24^{\circ} 45'$, p = 246.738, and h = 589.114, Ans.
- 4. Given b = 47, $P = 35^{\circ}$, to find B, p, and h. B = 55°, p = 32.91, and h = 57.376, Ans.
- 5. Given p = 275, $B = 58^{\circ}$, to find P, b, and h. $P = 32^{\circ}$, b = 440,92, and h = 518.946, Ans.
- 6. Given p = 15, b = 25, to find P, B, and h. (Use formula 6.) h = 29.05, B = 59° 23' 3", and P = 30° 36' 57", Ans.

PROBLEM II.

To show that the sines of the angles, in any plane triangle, are respectively proportional to their opposite sides.

Let ABC be any plane triangle, and from any vertex as B draw a perpendicular BD to the opposite side AC, making two right-angled triangles, ABD and BCD; from which we have in the triangle ABD, BD = $\frac{\sin A \times c}{R}$, and in the



triangle BCD, BD = $\frac{\sin C \times a}{R}$; $:: \sin A \times c = \sin C \times a$; hence, $\sin A : \sin C :: a : c$, and by inversion, $\sin C : \sin A :: c : a$, and $\sin B : \sin A :: b : a$, and $\sin A : \sin B :: a : b$; hence, in any triangle, the sines of the angles are respectively proportional to their opposite sides.

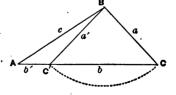
EXAMPLES.

- 1. Given $A = 55^{\circ}$, $B = 51^{\circ}$, c = 143, to find C, a, and b. $C = 74^{\circ}$, a = 121.86, and b = 151.61, Ans.
- 2. Given A = 60, c = 54, and $A = 26^{\circ}$, to find B, C, and b. $C = 23^{\circ} \cdot 10' \cdot 13''$, $B = 130^{\circ} \cdot 45' \cdot 47''$, and b = 103.667, Ans.

REM.—If c is greater than a there is two triangles; thus, c = 60, a = 54, and $A = 26^{\circ}$.

Observe, that the angle AC'B is the supplement of ACB.

 $C = 29^{\circ} 8' 56'', C' = 150^{\circ} 51'$ 4", $B = 124^{\circ} 51' 4'', B' = 3^{\circ} 8'$ 56'', b = 101.089, and b' = 6.7665, Ans.



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PROBLEM III.

To show by Diagram No. 2 certain relations of the functions of angles, when the radius is unity.

In the triangle CEB,

$$\overline{BE^2 + \overline{CE}^2} = \overline{CB^2};$$
that is, $\sin^2 C + \cos^2 C = R^2 = 1$, (1)
$$\sin^2 C = 1 - \cos^2 C,$$
 (2)
$$\cos^2 C = 1 - \sin^2 C.$$
 (3)

The triangles CEB and CAT are similar, and also CFB and CDT' are similar.

$$\therefore CE : CA :: EB : AT,
\cos C : 1 :: \sin C : \tan C,
\cos C \times \tan C = \sin C,
\tan C = \frac{\sin C}{\cos C}; (5)$$

$$\therefore \cot C = \frac{\cos C}{\sin C}, (7)$$

$$\tan C \times \cot C = \frac{\sin C}{\cos C} \times \frac{\cos C}{\sin C} = 1;$$

$$\therefore \tan C = \frac{1}{\cot C}, (8)$$

REM.—In the above diagram, C represents any angle; hence the relations apply to all angles.

SYNOPSIS OF THE FORMULAS.

$$\sin^2 + \cos^2 = 1.$$
 $\sin^2 = 1 - \cos^2.$
 $\cos^2 = 1 - \sin^2.$
 $\sin = \cos \times \tan g.$
(4)

 $\tan g = \frac{\sin}{\cos}.$
(5)
 $\cos = \sin \times \cot.$
(6)
 $\cot = \frac{\cos}{\sin}.$
(7)

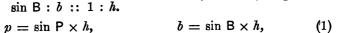
 $\tan g = \frac{1}{\cot}.$
(8)
 $\cot = \frac{1}{\tan g}.$
(9)

PROBLEM IV.

To show the relations of the functions of a rightangled triangle with the sides, when the radius is unity.

The triangles PDC and PHB are similar, and give the proportions,

CD : BH :: PC : PB, PD : PH :: PC : PB. and $\sin \mathsf{P} : p :: 1 : h,$



$$h = \frac{p}{\sin P}, \qquad \qquad h = \frac{b}{\sin B}, \qquad \qquad (2)$$

$$\sin P = \frac{p}{\bar{h}}, \qquad \sin B = \frac{b}{\bar{h}}.$$
 (3)

From (2),
$$\frac{p}{\sin P} = \frac{b}{\sin B}$$
, $\therefore \sin P : \sin B :: p : b$.

The triangles PFE and PHB are similar;

$$\therefore \quad \mathsf{BH} : \mathsf{EF} \ :: \ \mathsf{PH} : \mathsf{PF},$$

$$p : \mathsf{tang} \ \mathsf{P} \ :: \ b : 1;$$

$$hence, \qquad p = \mathsf{tang} \ \mathsf{P} \times b,$$

$$b = \frac{p}{\mathsf{tang} \ \mathsf{P}};$$
and by a similar process,
$$b = \mathsf{tang} \ \mathsf{B} \times p,$$

$$p = \frac{b}{\mathsf{tang} \ \mathsf{B}};$$

$$\mathsf{tang} \ \mathsf{P} = \frac{p}{b} = \mathsf{cot} \ \mathsf{B},$$
and
$$\mathsf{tang} \ \mathsf{B} = \frac{b}{p} = \mathsf{cot} \ \mathsf{P}.$$

$$(5)$$

and

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ENUNCIATION OF FORMULAS.

1. Either side is equal to the product of the sine of the opposite angle and the hypothenuse.

2. The hypothenuse is equal to either side, divided by the

sine of the angle opposite that side.

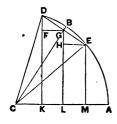
3. The sine of either acute angle is equal to its opposite side divided by the hypothenuse.

- 4. Either side is equal to the product of the tangent of its opposite angle and the other side; or, either side is equal to the other side divided by the tangent of the angle opposite that other side.
- 5. The tangent of either angle is equal to its opposite side divided by the other side.

REM.—In computing these formulas by logarithms, when the formula consists of the product of two numbers, 10 must be subtracted from the sum of the logarithms; and when it is fractional, 10 must be added to the difference of the logarithms.

PROBLEM V.

To find the sine and cosine of the sum and difference of two arcs, whose sines and cosines are known.



٠.

and

Let ACB and BCD be the two angles whose sines and cosines are known.

Let the angle ACB be designated angle A.

" " BCD " " " B.

Make
$$BCE = BCD$$
;

then
$$DK = \sin (A + B)$$
,

and
$$EM = \sin (A - B)$$
.

$$CK = \cos (A + B),$$

$$CM = \cos (A - B)$$
.

The triangles DFG and GHE are equal and similar to CLG, whose sides are respectively perpendicular to those of DFG and GHE.

the angle
$$FDG = angle LCG = angle A$$
.

In the triangle DFG.

$$DF = DG \times \cos A$$

and in the triangle CLG,

$$GL = CG \times \sin A$$
.
 $DF = \sin B \times \cos A$,

and

$$GL = \cos B \times \sin A$$

GL + DF = DK =
$$\sin (A+B) = \sin A \times \cos B + \cos A \times \sin B$$

GL - DF = EM = $\sin (A-B) = \sin A \times \cos B - \cos A \times \sin B$
By addition,

$$\sin (A + B) + \sin (A - B) = 2 \sin A \times \cos B$$

and $\sin (A + B) - \sin (A - B) = 2 \cos A \times \sin B$.

Put
$$A + B = M$$
, and $A - B = N$;

then
$$A = \frac{1}{2}(M + N)$$
, and $B = \frac{1}{2}(M - N)$;

then
$$\sin M + \sin N = 2 \sin \frac{1}{2} (M + N) \times \cos \frac{1}{2} (M - N)$$
, (1)

and
$$\sin M - \sin N = 2 \cos \frac{1}{2} (M+N) \times \sin \frac{1}{2} (M-N);$$
 (2)

dividing (1) by (2), and reducing by
$$\tan g = \frac{\sin}{\cos}$$
,

$$\frac{\sin M + \sin N}{\sin M - \sin N} = \frac{\sin \frac{1}{2}(M+N) \times \cos \frac{1}{2}(M-N)}{\cos \frac{1}{2}(M+N) \times \sin \frac{1}{2}(M-N)} = \frac{\tan \frac{1}{2}(M+N)}{\tan \frac{1}{2}(M-N)}$$
(3)

In the triangle CLG, $CL = CG \times \cos A = \cos B \times \cos A$.

"

"

"

DFG, $FG = DG \times \sin A = \sin B \times \sin A$.

By subtraction and addition,

$$\begin{array}{l} \text{CL} - \text{FG} = \text{CK} = \cos M = \cos A \times \cos B - \sin A \times \sin B \\ \text{CL} + \text{FG} = \text{CM} = \cos N = \cos A \times \cos B + \sin A \times \sin B \end{array}$$

Cor.—By addition and subtraction,

$$\cos M + \cos N = 2 \cos \frac{1}{2} (M + N) \times \cos \frac{1}{2} (M - N),$$
 (4)

$$\cos M - \cos N = -2 \sin \frac{1}{2} (M + N) \times \sin \frac{1}{2} (M - N); (5)$$

dividing (5) by (4),

$$\frac{\cos M - \cos N}{\cos M + \cos N} = \frac{-\sin \frac{1}{2}(M+N)}{\cos \frac{1}{2}(M+N)} \times \frac{\sin \frac{1}{2}(M-N)}{\cos \frac{1}{2}(M-N)} \\ = -\tan g \frac{1}{2}(M+N) \times \tan g \frac{1}{2}(M-N).$$

Observe that the tangent has a negative sine, which is correct, as the numerator of the first member of the equation is negative, the cosine N being greater than the cos M; a small angle has a larger cosine than a large angle.

EXAMPLES.

1. To find the sine and cosine of 30°, 60°, and 45°, when the radius is 1.

The sine of 30° is half the chord of 60°, the chord of 60° is radius = 1; hence, sine of 30° = $\frac{1}{2}$, and cosine of 60° = $\frac{1}{2}$.

$$\therefore \sin 30^\circ = \cos 60^\circ = \frac{1}{4}.$$

Cosine of
$$30^{\circ} = \sqrt{1 - \frac{1}{4}} = \sqrt{\frac{3}{4}} = \frac{1}{2}\sqrt{3}$$
; sine of $60^{\circ} = \frac{1}{2}\sqrt{3}$; and $\cos 30^{\circ} = \sin 60^{\circ} = \frac{1}{2}\sqrt{3}$.

When the angle is 45°, the sine and cosine will be equal, and as $\sin^2 + \cos^2 = 1$, that is, $\frac{1}{2} + \frac{1}{2} = 1$.

$$\sin^2 45^\circ = \frac{1}{2}$$
, and $\sin 45^\circ = \sqrt{\frac{1}{2}} = \frac{1}{2}\sqrt{2} = \cos 45^\circ$,
and $\sin 45^\circ = \cos 45^\circ = \frac{1}{2}\sqrt{2}$.

2. To find the sine, cosine, tangent, and cotangent of every arc from 1° to 90°.

The semi-circumference, when the radius is 1, is 3.1415926535; which being divided by 10800, the number of minutes it contains, gives the length of 1', equal to .0002908882, which in so small an arc does not differ materially from the sine of 1', and may be regarded as such; and $\cos 1' = \sqrt{1 - \sin^2 1'} = .99999999577$.

By taking the formula from Prob. 5,

$$\sin (A + B) + \sin (A - B) = 2 \sin A \times \cos B$$

by transposition,

$$\sin (A + B) = 2 \sin A \times \cos B - \sin (A - B),$$

and making B = 1', and A = 1', 2', 3', 4', etc., in succession,

$$\sin 1' = .0002908882;$$

$$\sin 2' = 2 \sin 1' \times \cos 1' - \sin 0 = .0005817764;$$

$$\sin 3' = 2 \sin 2' \times \cos 1' - \sin 1' = .0008726646.$$

By continuing this process, we can get the sines of every arc from 1' to 90°; and taking them in an inverse order, we have the cosines of every arc from 1' to 90°; then, as tang $=\frac{\sin}{\cos}$, we can get the tangents of every arc from 1' to 90°; and by taking them in an inverse order we have the cotangents of every arc from 1' to 90°. These will form a table of natural sines, cosines, tangents and cotangents.

The logarithms of these numbers, with the addition of 10 to to each logarithm, forms the table of logarithmic sines, cosines, etc. In the table the radius is taken as ten billions, whose logarithm is 10; and as the functions are proportional to the radii, hence the natural sines, etc., must be multiplied by this number, which is done by adding the logarithms of the natural sine, etc., and of the radius.

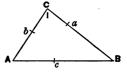
PROBLEM VI.

Two sides and the included angle of a triangle given, to find the other angles.

By Problem 2,

$$a:b::\sin A:\sin B$$
;

by composition and division,



$$a+b:a-b: \sin A + \sin B: \sin A - \sin B,$$

$$\therefore \frac{a+b}{a-b} = \frac{\sin A + \sin B}{\sin A - \sin B}.$$

By Problem 5, Formula (3),

$$\frac{\sin\,M+\sin\,N}{\sin\,M-\sin\,N}=\frac{\tan g\,\frac{1}{2}\,(M+N)}{\tan g\,\frac{1}{2}\,(M-N)};$$

$$\therefore \frac{a+b}{a-b} = \frac{\sin A + \sin B}{\sin A - \sin B} = \frac{\tan \frac{1}{2}(A+B)}{\tan \frac{1}{2}(A-B)};$$

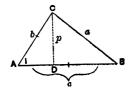
hence the proportion,

$$a + b : a - b :: \tan \frac{1}{2} (A + B) : \tan \frac{1}{2} (A - B)$$

Knowing the sum and difference of two angles, we easily find the angles.

PROBLEM VII.

To find the area of a triangle, having given two sides and the included angle.



The angle A and the sides \boldsymbol{b} and c ven.

area ABC = $\frac{1}{2}$ pc.

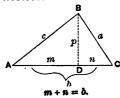
In the triangle ADC,

$$p = \sin A \times b$$
;

area of ABC = $\frac{1}{2}b \times c \times \sin A$.

PROBLEM VIII.

If from the vertex of any angle of a triangle a line be drawn perpendicular to the opposite side, produced if necessary, then will the sum of the segments of the opposite side be to the sum of the other two sides as the difference of those sides is to the difference of the segments.



$$p^{2} = a^{2} - n^{2} = c^{2} - m^{2},$$

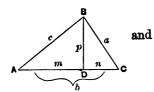
$$m^{2} - n^{2} = c^{2} - a^{2},$$

$$(m+n)(m-n) = (c+a)(c-a),$$

$$m+n: c+a :: c-a: m-n.$$

PROBLEM IX.

If from the half sum of the three sides of a triangle, each side be subtracted separately, then the square root of the continued product of the half sum and the three remainders will be the area of the triangle.



$$p^{2} = c^{2} - m^{2} = a^{2} - n^{2},$$

$$c^{2} - a^{2} = m^{2} - n^{2},$$

$$m^{2} - n^{2} = c^{2} - a^{2},$$

$$(m+n)(m-n) = c^{2} - a^{2};$$

and as

$$m + n = b,$$

$$b (m - n) = c^{2} - a^{2},$$

$$m - n = \frac{c^{2} - a^{2}}{b},$$

$$\frac{m + n = b,}{2m}$$

$$= b + \frac{c^{2} - a^{2}}{b},$$

$$m = \frac{b^{2} + c^{2} + a^{2}}{2b},$$

$$p^{2} = c^{2} - m^{2} = c^{2} - \left(\frac{b^{2} + c^{2} - a^{2}}{2b}\right)^{2},$$

$$p = \sqrt{\frac{4b^{2}c^{2} - (b^{2} + c^{2} - a^{2})^{2}}{4b^{2}}}$$

$$= \sqrt{\frac{(2bc + b^{2} + c^{2} - a^{2})[2bc - (b^{2} + c^{2} - a^{2})]}{4b^{2}}}$$

$$= \sqrt{\frac{[(b + c)^{2} - a^{2}] \times [a^{2} - (b - c)^{2}]}{4b^{2}}}$$

and

area of ABC
$$= \frac{1}{2}pb$$

$$=\sqrt{\frac{(\overline{b}+\overline{c}+a)(\overline{b}+\overline{c}-a)(\overline{a}+\overline{b}-\overline{c})(\overline{a}+\overline{c}-b)}{4b^2}}\times\sqrt{\frac{\overline{b^2}}{4}};$$

 $=\sqrt{\frac{(b+c+a)(b+c-a)(a+b-c)(a+c-b)}{4b^2}}$

b2 is canceled, and the two 4's factored,

area of ABC =
$$\sqrt{rac{(\overline{b}+\overline{c}+a)}{2}rac{(\overline{b}+\overline{c}-a)}{2}rac{(a+\overline{b}-c)}{2}rac{(a+\overline{c}-\overline{b})}{2}}$$
.

EXAMPLES.

Two sides and the included angle given.

1. Given
$$a = 75$$
, $b = 90$, and $C = 20^{\circ}$, to find A, B, and e.
 $b + a : b - a :: tang. \frac{1}{2} (B + A) : tang. \frac{1}{2} (B - A);$
 $165 : 15 :: tang. 80^{\circ} : tang. B - A.$
 $tang. \frac{1}{2} (B - A) = log 15 + log tang. 80^{\circ} - log 165,$
 $\frac{1}{2} (B + A) = 80^{\circ} 00' 00'',$
 $\frac{1}{2} (B - A) = \frac{27}{16} \frac{16}{27}.$
 $B = \frac{107^{\circ}}{16'} \frac{16'}{27''},$
 $A = 52^{\circ} \frac{43'}{33''}.$

Sin A : sin C :: a : c,

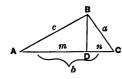
 $\log c = \log \sin C + \log a - \log \sin A$.

Arith. comp. 165	=	7.782516
log 15	=	1.176091
log tang. 80°	=	10.753681
$tang. + (B-A) = 27^{\circ} 16' 27'$	<i>"</i> =	9.712288

Arith. comp.
$$\sin 52^{\circ} 43' 33'' = 0.099225$$

 $\log \sin C 20^{\circ} 9.534052$
 $\log a 75 \frac{1.875061}{1.508338}$

When the three sides are given.



2. Given
$$a = 237$$
, $b = 495$, and $c = 327$.
 $m + n : c + a :: c - a : m - n$;
 $m + n = b$,
 $\log (m - n) = \log (c + a) + \log (c - a)$
 $- \log b$.

$$m + n = 495$$

 $m - n = 102.546$
 $m = 298.773$,
and $n = 196.227$.

In the triangle ABD,

$$c:m::R:\sin ABD$$
;

 $\log \sin ABD = \log R + \log m - \log c.$

Arith. comp. 495	=	7.305395
log 564	=	2.751279
log 90	=	1.954243
(m-n) = 102.546		2.010917

Arith. comp. 327	7.485452
log 298.773	2.475342
log R	10.000000
$\sin ABD = \cos A 23^{\circ} 59'$	9.960794

In the triangle BDC, $a:n::R:\cos C$; $\log \cos C = \log n + \log R - \log a$.

A = 23° 59′ 00″
C = 34° 6′ 36″

$$180 - 58°$$
 5′ 36″ = 121° 54′ 24″ = B.

Arith. comp. 237 = 7.625252 log 196.227 = 2.292759 log R 10.0000000 cos C 34° 6′ 36″ 9.918011

PROBLEM.

A side and two adjacent angles given, also two sides and an angle opposite one of them.

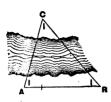
EXAMPLES.

- 1. Given A = 32°, a = 40, and b = 50, to find B, C, and c. Ans. {B = 41° 28′ 59″, C = 106° 31′ 1″, and c = 72.368. B = 138° 31′ 1″, C = 9° 28′ 59″, " c = 12.436. In this case there are two triangles.
 - 2. Given a = 450, b = 540, and $C = 80^{\circ}$, to find A, B, and c. A = 43° 49′, B = 56° 11′, and c = 640.08.
- 3. Given a=40, b=34, and c=25 yards, to find the angles. $A=83^{\circ} 53' 16''$, $B=57^{\circ} 41' 24''$, and $C=38^{\circ} 25' 20''$.
- 4. Given b = 306, c = 274, and $B = 78^{\circ} 13'$, to find A, C, and a. A = 40° 33', C = 61° 14', and a = 203.2.
- 5. Given B = 100°, a = 280.3, and c = 304, to find A, C, and b. A = 38° 3′ 3″, C = 41° 56′ 57″, and b = 447.856.
- 6. Find the area of a triangle having two sides equal to 30 and 40 ft. respectively, and the included angle 28° 57′,
- 7. Find the area of a triangle whose sides are respectively 30, 40, and 50 rods.

 Ans. 3 acres 3 rods.
- 8. What is the area of a triangle, whose base is 50 rods and altitude 30 rods?

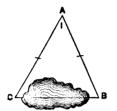
 Ans. 4 acres 2 rods 30 perches.

PRACTICAL PROBLEMS.



1. Find the distance AC across a deep river, having given AB = 500 yards, the angle BAC = 74° 14', and the angle ABC = 49° 23'.

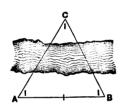
 $\sin C : \sin B :: c : b;$ $\log b = \log \sin B + \log c - \log \sin C$ = 577.8 yards.



2. Given AC = 735 yards, BC = 840, and the angle $C = 55^{\circ} 40'$, to find AB.

Two sides and the included angle.

$$AB = 741.$$

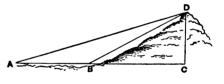


3. Given AB = 600 yards, and the adjacent angles $A = 57^{\circ} 35'$ and $B = 64^{\circ} 51'$, to find the angle C and the sides AC and BC.

$$AC = 643.49 \text{ yards.}$$

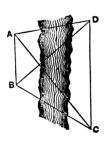
 $BC = 600.11$ "

4. Find the height of D a point on a mountain above a horizontal plane. The angle of elevation at B, a point at the foot of the mountain, is 27° 29';



and at A distant from B 975 yards, in a direct line from B, and in the plane DBA, is 15° 36'.

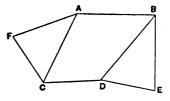
$$DC = 587.61$$
 yards.



5. Wishing to know the distance between two inaccessible objects C and D, I measured a line, AB = 339 feet, from both ends of which the objects were visible; I found the angles $BAD = 100^{\circ}$, $BAC = 36^{\circ}$ 30', $ABC = 121^{\circ}$, and $ABD = 49^{\circ}$; find the distance DC.

$$DC = 697\frac{1}{2}$$
 feet.

6. Wishing to know the distance between two inaccessible objects, A and B, and finding no place from which both could be seen, two points C and D, 200 yards distant, were found; from the former point A could be seen,



and from the latter B; from C, a distance of 200 yards were measured to a point F, from which A could be seen; and from D the same distance was measured to E, from which B could be seen, and the following angles taken, viz.,

$$ACD = 53^{\circ} \ 20', \qquad BDC = 156^{\circ} \ 25', \\ ACF = 54^{\circ} \ 31', \qquad BDE = 54^{\circ} \ 30', \\ AFC = 83^{\circ} \ 00', \qquad BED = 88^{\circ} \ 30'.$$

and

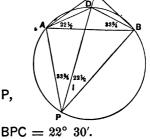
Find the distance AB.

Ans. AB = 345.467 yards.

7. The distance between three points A, B, and C, are known, viz.,

and

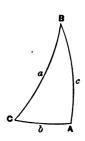
All are visible from a distant point P, at which the angles are measured,



APC = 33° 45', Find AP, BP, and CP.

SPHERICAL TRIGONOMETRY.

Spherical Trigonometry treats of spherical triangles, the sides of which are arcs of great circles, each less than 180°, and the angles are diedral angles, formed by the planes of the great circles; each angle is less than two right angles.



Napier's Five Circular Parts form the basis for the analysis of the functions of right-angled spherical triangles.

The two sides about the right angle, and the complements of the hypothenuse and of the two oblique angles are the five circular parts.

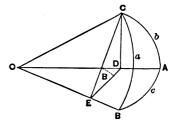
The spherical triangle ABC is right-angled at A. The sides b and c, and the complements of the hypothenuse a and of the angles B and C

are the five circular parts.

In taking any three of these parts, they will either be found to be adjacent to each other, or one of them will be separated from both the others. When they are adjacent, the one lying

between the others is called the middle part, and when they are not adjacent, the one separated from both the others is the middle part and the others are opposite.

Let ABC be a spherical triangle, right-angled at A, O the center of the sphere. Draw CD perpendicular to OA, and DE per-



pendicular to OB, and join CE. As the angle A is a right angle, the angle CDE is also a right angle, as CD is perpendicular to the

plane ABO in which DE is drawn perpendicular to OB, a line of the plane; hence CE is perpendicular to OB (Th. 3, Bk. 6), and CED = B.

- 1. $\sin b = \sin a \times \sin B = \cos \text{ comp. } a \times \cos \text{ comp. } B$.
- 2. $\sin c = \sin a \times \sin C = \cos \text{comp.} \ a \times \cos \text{comp.} \ C$.
- 3. $\cos B = \cos b \times \sin C = \cos b \times \cos \text{comp. } C = \sin \text{ comp. } B$.
- 4. $\cos C = \cos c \times \sin B = \cos c \times \cos c$ B = $\sin c$ C.
- 5. $\cos a = \cos b \times \cos c = \cos b \times \cos c = \sin \text{ comp. } a$.

By Prob. 4, in the triangle CED,

$$CD = CE \times \sin B,$$

$$\therefore \sin b = \sin a \times \sin B.$$
 (1)

No. 2 is derived in the same way, by making B the vertex instead of C.

$$\cos B = \frac{DE}{CE} = \frac{DE}{\sin a}$$
.

 $DE = \cos b \times \sin a$.

 $\sin c = \sin a \times \sin C$. (2)

In the triangle OED,

$$DE = OD \times \sin DOE$$
,

$$\therefore \cos B = \frac{\cos b \times \sin a \times \sin C}{\sin a} = \cos B \times \sin C.$$
 (3)

In No. 4, cos C is found like cos B, by making B the vertex. In the triangle ODE,

OE = OD
$$\times$$
 cos DOE;
that is, $\cos a = \cos b \times \cos c$. (5)

From these five formulas, five others may be derived; thus,

1.
$$\sin b = \sin a \times \sin B = \frac{\sin c \times \cos C}{\sin C \times \cos c} = \frac{\sin c}{\cos c} \times \frac{\cos C}{\sin C}$$

= $\tan c \times \cot C = \sin b$.

2.
$$\sin c = \sin a \times \sin C = \frac{\sin b}{\sin B} \times \frac{\cos B}{\cos b} = \frac{\sin b}{\cos b} \times \frac{\cos B}{\sin B}$$

= $\tan b \times \cot B = \sin c$.

3.
$$\cos B = \cos b \times \sin C = \frac{\cos a \times \sin c}{\cos c \times \sin a} = \frac{\cos a}{\sin a} \times \frac{\sin c}{\cos c}$$

= $\tan c \times \cot a = \sin c$. B.

4.
$$\cos C = \cos c \times \sin B = \frac{\cos a \times \sin b}{\cos b \times \sin a} = \frac{\sin b}{\cos b} \times \frac{\cos a}{\sin a}$$

= $\tan b \times \cot a = \sin comp. C.$

5.
$$\cos a = \cos b \times \cos c = \frac{\cos B}{\sin C} \times \frac{\cos C}{\sin B} = \frac{\cos B}{\sin B} \times \frac{\cos C}{\sin C}$$

= $\cot B \times \cot C = \sin comp. a$.

From the first five formulas:

The sine of the middle part is equal to the product of the sines of the opposite parts.

From the second:

The sine of the middle part equals the product of the tangents of the adjacent parts.

REM.—Observe that the cosine of an angle is equal to the sine of the complement, and the cotangent is equal to the tangent of the complement.

THE SPECIES OF THE FUNCTIONS OF ANGLES OR ARCS.

As the functions of an arc and of its supplement are lines of equal length, there is a distinction necessary, in order that we may know whether the arc is greater or less than 90°; hence the minus sign is given to the cosine, the tangent, and the cotangent when the arc is greater than 90°, or terminates in the second quadrant.

Two arcs are said to be of the same species when they are both less or both greater than 90°, and of different species when the one is greater and the other less than 90°

1. From the 3d and 4th formulas of circular parts,

$$\sin C = \frac{\cos B}{\cos b}$$
, and $\sin B = \frac{\cos C}{\cos c}$

As the sines of C and B are both positive, hence the cosines of each oblique angle must have the same sign as the cosines of

the opposite sides; consequently, the oblique angles and their opposite sides are of the same species.

2. When the hypothenuse is less than 90°, the other two sides and their opposite angles are of the same species; for, as

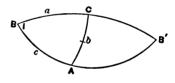
$$\cos a = \cos b \times \cos c$$
,

and when a is less than 90° its cosine is positive; hence the cosines of b and c have like signs, that is, b and c are of the same species. But when a is greater than 90°, its cosine is negative; hence the cosines of b and c have different signs; that is, b and c are of different species.

By these two rules the nature of each result is determined, except when an oblique angle and the opposite side are given, to find the other parts.

Let ABC be right-angled at A; and B and b be known.

1st. If the sine of b is greater than the sine B, there can be no solution; for, as $\sin a = \frac{\sin b}{\sin B} > 1$, which is impossible.



- 2d. If sine $b = \sin B$, then $\sin a = \frac{\sin b}{\sin B} = 1$; hence, the vertex B is the pole of the opposite side b, and a and c are each 90° .
- 3d. If sine b is less than sine B, when B is less than 90°, there will be two solutions, as shown in the above figure; as ABC and AB'C both fulfill the conditions. When B is greater than 90°; then, in order that $\sin b < \sin B$, the side b must be greater than the angle B; when the result will be the same as above, and a and c in the one triangle will be complements of the same letters in the other triangle.

EXAMPLES.

1. Given $a = 86^{\circ} 51'$, and $B = 18^{\circ} 3' 32''$, to find b, c, and C.

1.
$$\sin b = \sin a \times \sin B$$
,
5. $\cos c = \cos a \div \cos b$;
4. $\cos C = \cos c \times \sin B$.

$$\begin{array}{ll} \log \sin \, \mathsf{B} = 18^{\circ} \ \ 3' \ 32'' = 9.491354 \\ \cos c &= 86^{\circ} \ 41' \ 14'' = \underline{8.761826} \\ \mathsf{C} - 10 &= 88^{\circ} \ 58' \ 25'' = \underline{8.253180} = \cos \, \mathsf{C}. \end{array}$$

log sin
$$a = 86^{\circ} 51' = 9.999343$$

log sin $b = 18^{\circ} 3' 32'' = 9.491354$
 $b - 10 = 18^{\circ} 1' 50'' = 9.490697 = \sin b$.

log cos
$$a = 86^{\circ} 51' = 8.739969$$

log cos $b = 18^{\circ} 1' 50'' = 9.978143$
 $c + 10 = 86^{\circ} 41' 14'' = 9.761826 = \cos c$.

2. Given $b = 155^{\circ} 27' 54''$, and $c = 29^{\circ} 46' 8''$, to find a, B, and C.

Ans.
$$a = 142^{\circ} 9' 13''$$
, $B = 137^{\circ} 24' 21''$, and $C = 54^{\circ} 1' 16''$.

3. Given B = 47° 13′ 43″, and C = 126° 40′ 24″, to find a, b, and c.

Ans.
$$a = 133^{\circ} 32' 26''$$
, $b = 32^{\circ} 8' 56''$, and $c = 144^{\circ} 27' 3''$.

REM.—As the formulas are constructed with unity as radius, if logarithms are used, when the formula is a product, 10 must be subtracted, but when a quotient, 10 must be added.

A spherical triangle which has one of its sides a quadrant, is called a Quadrantal Triangle, and is readily solved by passing to its polar triangle, which will be right-angled, solving it, and returning to the quadrantal triangle.

The supplement of any side of a triangle is equal to the opposite angle of the polar triangle, and the supplement of any angle is equal to the opposite side of the polar triangle. The return is effected in the same way as each triangle is polar to the other.

PROBLEM I.

To show that the sines of the sides of a spherical triangle are respectively proportional to their opposite angles.

Let ABC be any oblique-angled triangle.

From either vertex, as A, draw an arc of a great circle perpendicular to the opposite side; then will the triangles ABD and ADE be rightangled at D, and B C

 $\sin b' = \sin c \times \sin B$;

and

$$\sin b' = \sin b \times \sin C$$
.

 \therefore $\sin b \times \sin C = \sin c \times \sin B$;

and

 $\sin b : \sin c :: \sin B : \sin C$.

In like manner, $\sin a : \sin b :: \sin A : \sin B$;

and $\sin a : \sin c :: \sin A : \sin C$.

The result is the same when the perpendicular falls on the opposite side produced.

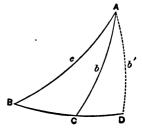
In the triangle ABD and in the triangle ACD,

 $\sin b' = \sin c \times \sin B;$

 $\sin b' = \sin b \times \sin C.$

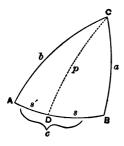
 \therefore sin $b \times \sin C = \sin c \times \sin B$; and

 $\sin b : \sin c :: \sin B : \sin C, \text{ etc.}$



PROBLEM II.

In an oblique-angled spherical triangle, if from the vertex of either angle an arc be drawn perpendicular to the opposite side, dividing it into two segments, find these segments.



Let ABC be any oblique-angled spherical triangle.

From either vertex, as C, draw CD an arc of a great circle perpendicular to the opposite side; then, from 5th formula of Napier, (s + s' = c).

In the triangle ACD and in the triangle BCD,

$$\cos b = \cos p \times \cos s';$$

 $\cos a = \cos p \times \cos s$.

$$\therefore \frac{\cos b}{\cos a} = \frac{\cos p \times \cos s}{\cos p \times \cos s} = \frac{\cos s'}{\cos s},$$
$$\cos a : \cos b :: \cos s : \cos s';$$

and

and by composition and division, $\cos a - \cos b : \cos a + \cos b :: \cos s - \cos s' : \cos s + \cos s'$.

$$\therefore \frac{\cos a - \cos b}{\cos a + \cos b} = \frac{\cos s - \cos s'}{\cos s + \cos s'};$$

and from Prob 5, Plane Trig.,

$$\frac{\cos M - \cos N}{\cos M + \cos N} = -\frac{\sin \frac{1}{2} (M + N) \times \sin \frac{1}{2} (M - N)}{\cos \frac{1}{2} (M + N) \times \cos \frac{1}{2} (M - N)}$$

$$= -\tan g \cdot \frac{1}{2} (M + N) \times \tan g \cdot \frac{1}{2} (M - N).$$

$$\therefore \frac{\cos a - \cos b}{\cos a + \cos b} = -\tan \beta \cdot \frac{1}{2} (a + b) \times \tan \beta \cdot \frac{1}{2} (a - b);$$

and
$$\frac{\cos s - \cos s'}{\cos s + \cos s'} = -\tan g. \frac{1}{2} (s + s') \times \tan g. \frac{1}{2} (s - s').$$

And

tang.
$$\frac{1}{2}(s+s') \times \tan g$$
. $\frac{1}{2}(s-s') = \tan g$. $\frac{1}{2}(a+b) \times \tan g$. $\frac{1}{2}(a-b)$;
 $\therefore \tan g$. $\frac{1}{2}(s+s') : \tan g$. $\frac{1}{2}(a+b) :: \tan g$. $\frac{1}{2}(a-b) : \tan g$. $\frac{1}{2}(s-s')$.

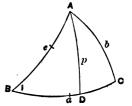
REM.—s and s' being determined, in each right-angled triangle are known two sides and an angle opposite one of them.

PROBLEM III.

When two sides and the included angle are given, to find the other parts.

Let ABC be an oblique spherical triangle, a, c, and B given.

From A draw AD an arc of a great circle perpendicular to the opposite side BC, and in the triangle ABD,



$$\sin p = \sin c \times \sin B;$$

and
$$\sin BAD = \frac{\cos B}{\sin p};$$

and $\sin BD = \sin c \times \sin BAD.$

$$DC = a - BD;$$

 $\cos b = \cos p \times \cos DC;$

$$\sin C = \frac{\sin p}{\sin b};$$

and
$$\sin CAD = \frac{\sin DC}{\sin b}$$

angle A = angle BAD + angle CAD;

hence, b, A, and C are determined.

PROBLEM IV.

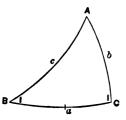
When a side and the two adjacent angles are given.

Let B, C, and a be given; then in the polar triangle,

$$b = 180 - B,$$

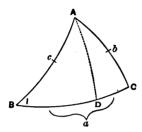
 $c = 180 - c,$
and $A = 180 - a;$

that is, two sides and the included angle known. Solve the polar triangle by Problem 3, and return to the original triangle.



PROBLEM V.

When two sides and an angle opposite one of them is given.



Let B, b, and c be given, and from the angle A, opposite the unknown side a, draw an arc of a great circle perpendicular to it.

In the triangle ABD,

$$\sin p = \sin c \times \sin B$$
, $\sin BAD = \frac{\cos B}{\cos p}$, and $\sin BD = \sin c \times \sin BAD$.

In the triangle ADC,

$$\cos DC = \frac{\cos b}{\cos p}$$
,
 $\sin CAD = \frac{\sin DC}{\sin b}$,
 $angle A = angle BAD + angle CAD$;

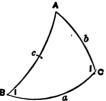
and

hence all the parts are determined.

REM.—When the three sides are given, the angles are found by this problem, after having found the segments of one side by Problem 2.

PROBLEM VI.

When two angles and a side opposite one of them is given.



Let B, C, and c be given; then, in the polar triangle,

$$b = 180 - B,$$

 $c = 180 - C,$
and $C = 180 - c;$

the same as in Problem 5, and must be solved accordingly, and then return to the original triangle.

PROBLEM VII.

To find the area of a spherical polygon.

When the angles are not given, find them by the foregoing problems; then from Geometry, Book 8,

The area of a spherical triangle is equal to the product of its spherical excess and the trirectangular triangle, and the same for any polygon.

EXAMPLES.

1. What is the area of a spherical triangle on the surface of a sphere whose diameter is 20 feet; the angles of the triangle are $A = 130^{\circ}$; $B = 110^{\circ}$; and $C = 165^{\circ}$.

$$\begin{array}{lll} 130 & & & & & \\ 110 & & & & \\ 165 & & & & \\ \hline 405 & & & & \\ \hline 405 & & & & \\ \hline 225 & & & \\ \hline 90 & & & \\ \hline \end{array}$$
 surface of trirectangular triangle = $\frac{20^2 \times 3.1416}{8}$ = 157.08 \times = 157.08 \times = 392.7 sq. ft., Ans.

2. What is the area of a spherical polygon of five sides on a sphere whose diameter is 40 feet, and the sum of the angles of the polygon is 660°.

$$\frac{40^2 \times 3.1416}{8} \times \frac{4}{3} = 40 \times 5 \times 1.0472$$
= 209.44 sq. ft., Ans.

3. Find the area of a spherical polygon of eight sides, on a sphere 30 feet in diameter, and each angle of the polygon being 150 degrees.

$$\frac{30^2 \times 3.1416}{8} \times \frac{4}{3} = 30 \times 10 \times 1.5708$$
$$= 471.24 \text{ sq. ft., } Ans.$$

PROBLEM VIII.

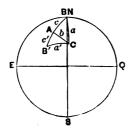
To find the shortest distance, on the surface of the earth, between two places whose latitudes and longitudes are known.

REM.—The shortest distance between two points on the surface of the earth is measured on the arc of a great circle joining the points.

EXAMPLES.

1. The latitude of New York City is 40° 48'; its longitude 3° east; the latitude of San Francisco is 37° 45' north, and its longitude 45° 40' west. What is the distance between them?

The radius of the earth is 3962 miles, making 69.15 miles to a degree. Ans. 37° 18' 46'' = 2580.18 miles.



Let this figure represent a hemisphere; NS a meridian passing through Washington; EQ, equator. The point C represents New York, and B' San Francisco; the point B is at the North Pole; BC and BB' are the colatitudes of New York and San Francisco, and the angle B the difference of longitude of C and B'.

From C draw CA perpendicular to BB'; then in the triangle BB'C, angle $B = 48^{\circ} 40'$, the side $a = 49^{\circ} 12'$, and $BB' = 52^{\circ} 15$;

and as
$$\sin b = \sin a \times \sin B = 34^{\circ} 38' 23''$$

$$\cos c = \frac{\cos a}{\cos b} = 37^{\circ} 25' 14''$$

$$c' = 52^{\circ} 15' - 37^{\circ} 25' 14'' = 14^{\circ} 49' 46'';$$

and $\cos a' = \cos b \times \cos c' = 37^{\circ} 18' 46'' = 2580.18$ miles.

- 2. The latitude and longitude of New York given, also the distance from New York to San Francisco, and the latitude of the latter place, to find its longitude.
- 3. Given the latitude and longitude of New York, the distance to San Francisco and its longitude, to find the latitude.

REM.—The student will become more familiar with the principles by finding the different parts of the same problem, than by taking different ones.

PROBLEM IX.

To find the hour of the day; the altitude of the sun, its declination and the latitude of the observer being given.

The spherical triangle of which we know the three sides are in the celestial concave. Its vertices are the sun, the zenith of the observer, and the Celestial Pole, or the point in the heavens pierced by the axis of the earth, perpendicular to the equator.

The arc of the great circle joining the sun and the pole is the codeclination of the sun, when the sun and the observer are both on the same side of the equator; when they are on different sides of the equator, it is the sum of the declination and 90°.

The Coaltitude of the sun is the arc of the great circle joining the sun and the zenith of the observer; and the

Colatitude of the observer is the arc joining the zenith and the pole.

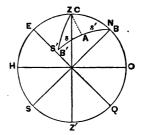
EXAMPLE.

In latitude 36° 40' the declination of the sun is 12° 20' N., and its altitude 30° 30'. What is the hour of the day?

Ans. Either 7h. 56 m. 2 sec. A.M., or 4h. 3 m. 58 sec. P.M.

In this example the three sides are given to find the angle at

the pole, which is the hour angle, and being reduced from degrees, etc., to hours, minutes, etc., by dividing by 15, gives either the time before or after 12 m. The angle having its vertex at the pole, one side of which extends from the pole to the sun, the other to the zenith.

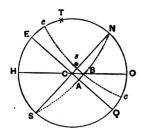


The sun, the zenith, and the celestial pole N are the vertices of the triangle

BCB'; the three sides are given. Draw CA perpendicular to BB'; then find the segments of c, s, and s'; and then the angle B, which reduce to hours, etc., and it is either so long before or after 12 o'clock m.

PROBLEM X.

To find the length of the day at any place, the latitude and declination of the sun being known.



Let NS be the meridian at which the sun reaches the horizon when it is on the equator; that is, when it rises at 6 o'clock. When the sun has a declination north, it will be at s on the ecliptic, instead of being at C on the same meridian at 6 o'clock.

It has already passed the distance Bs above the horizon, and the time

taken for this passage is in the same proportion to 24 hours, that this arc AC is to 360 degrees. The angle is ANC, and is measured by the arc AC.

In the triangle ABC, right angled at A, AB is equal to the declination of the sun; the angle ACB = ECH is the coaltitude of the place.

EXAMPLE.

What is the length of the day in latitude 40° 30′ north, when the declination of the sun is 12° 50′?

T will be the position of the traveler.

$$\sin b = \cot C \times \tan c;$$

$$c \cdot log tang. comp. C 40^{\circ} 30' = 9.931499$$

 $log tang. c - 10 12^{\circ} 50' = 9.357566$
 $sin b = sin C 11^{\circ} 13' 10'' = 9.289065$

Time before 6 o'clock that the sun rises and of course the same time after 6 it sets.

Twice the time of the sun passing from the horizon to the meridian NS must be added to 12 hours to get the length of the day.

REM.—As a traveler goes north, starting at the equator, for every degree that he travels, the south pole recedes one degree; therefore, the angle HCS measures his latitude, and HCE is his colatitude. This is the same as the north pole rising a degree for every degree he travels; hence, the altitude of the north pole is his latitude.

TABLE,

CONTAINING

THE LOGARITHMS OF NUMBERS

FROM 1 TO 10,000.

NUMBERS FROM 1 TO 100 AND THEIR LOGARITHMS,

WITH THEIR INDICES.

~~	$\sim\sim\sim$	\sim	$\sim\sim\sim$	\sim	~~~ ~~~	\sim	$\sim\sim\sim$	\sim	~~~
) No.	Logarithm.	No.	Logarithm.	No.	Logarithm.	No.	Logarithm.	No.	Loga ithm.
3 1	0.000000	21	1.322219	41	1.612784	61	1.785330	81	1.908495
\ 2	0.301030	22	1.342423	42	1.623249	62	1.792392	82	1.913814
⟨ 3	0.477121	23	1:361728	43	1.633468	63	1.799341	83	1.919078
\ \ \ \ \	0.602060	24	1.380211	44	1.643453	64	1.806180	84	1.924279
\ ŝ	0.698970	25	1.397940	45	1.653213	65	1.812913	85	1.929419
, ·	0 030310	~	1 03/540	40	1 000510	00	1 012515	•	
/ 6	0.778151	26	1.414973	46	1.662758	66	1.819544	86	1.934498
7	0.845098	27	1.431364	47	1.672098	67	1.826075	87	1.939519
} 8	0.903090	28	1.447158	48	1.681241	68	1.832509	88	1.944483
) ŏ	0.954243	29	1.462398	49	1.690196	69	1.838849	89	1.949390
) 1ŏ	1.000000	30	1.477121	50	1.698970	70	1.845098	90	1.954243
, 10	1 000000	1 30	1 4//121	1 -	1 030370	10	1 040090	80	1 304240
\ 11	1.041393	31	1.491362	51	1.707570	71	1.851258	91	1.959041
(12	1.079181	32	1.505150	52	1.716003	72	1.857332	92	1.963788
\ i3	1.113943	33	1 518514	53	1.724276	73	1.863323	93	1.968483
14	1 146128	34	1.531479	54	1.732394	74	1.69232	94	1.973128
13	1.176091	35	1.544068	55	1.740363	75	1.875061	95	1.977724
7 13	1.110091	33	1.244000	J 20	1.140303	13	1.013001	ອວ	1911124
16	1-204120	36	1.556303	56	1.748188	76	1.880814	96	1.982271
7 17	1.230449	37	1.568202	57	1.755875	77	1.886491	97	1.986772
} iis	1.255273	38	1.579784	58	1.763428	78	1.892095	98	1.991226
19	1.278754	39	1.591065	59	1.770852	79	1.897627	99	1.995635
20									
: 20	1.301030	40	1.602060	60	1.778151	80	1.903090	100	2.000000

Note.—In the following part of the Table, the Indices are omitted, as they can be very easily supplied. Thus, the index of the logarithm of every integer number, consisting only of one number, is 0; of two figures, 1; of three figures, 2; of four figures, 3: being always a unit less than the number of figures contained in the integer number. The index to the logarithm of every number above 100, in the following part of the Table, is omitted; yet, in the operation, it must be prefixed, according to this remark: so that the logarithm of 600 is 2.77815, and that of 6000 is 3.77815, and so of the rest.

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100			000868	001301							435
1	4321	4751	5181	5609							42
2	8600	9026	9451	9876	010300	010724	011147	011570	011993	012415	424
3	012837	013259	013680	014100	4521	4940	5360	5779			420
4	7033	7451	7868	8284	8700	9116	9532	9947	020361	020775	416
5	021189	021603	022016	022428	022841	02:1252	023664		4486		
6	5306	5715	6125	6533	6942	7350		8164	8571	8978	
7	9384	9789	030195			031408					
	033424		4227	4628	5029		5830				
9	7426	7825	8223	8620		9414		040207			
-					9017		ŀ	020201	I		39
110	041393	041787	042182	042576	042969	043362	043755	044148	044540	044932	393
1	5323	5714	6105	6495	6885		7664	8053	8442		390
2	9218	9606		050380							
		053463		4230	4613			5760			
4	6905	7286	7666	8046	8426		9185	9563		060320	270
5											
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6					5953			7071	7443		3/3
7	8186	8557	8928	9298		070038		070776	U71145		
				072985		3718	4085	4451	4816	5182	
9	5547	5912	6276	6640	7004	7368	7731	8094	8457	8819	363
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2	6360	6716	7071	7426	7781		8490	8845	9198	9552	
3				090963		091667		092370			
4	093422	3772	4122	4471	4820	5169	5518	5866	6215		
5	6910	7257	7604	7951	8298	8644	8990	9335		100026	346
6	100371	100715	101059	101403	101747	102091	102434	102777	103119	3462	343
7	3804	4146	4487	4828	5169	5510	5851	6191	6531	6871	341
8	7210	7549	7888	8227	8565	8903	9241	9579	9916	110253	339
9	110590	110926	111263	111599	111934	112270	112605	112940		3609	
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- 1	7271	7603	7934		8595	8926	9256	9586	9915	120245	330
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3	3852	4178	4504	4830	5156	5481	5806	6131	6456		32
4	7105	7429	7753	8076	8399	8722	9045	9368	9690	130012	323
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7	6721	7037	7354	7671	7987	8303	8618	8934	9249	9564	
8	9879	140194	140508		141136	141450				142702	
ğ	143015	3327	3639	3951	4263	4574	4885	5196	5507	5818	
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1	9219	9527	9835			150756	151063	151370	151676	151982	
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3	5336	5640	5943	6246	6549	6852	7154	7457	7759	8061	
4	8362	8664	8965	9266	9567	9868		160469			
5	161368	161667	161967		162564		3161	3460	3758	4055	
6	4353	4650	4947	5244	5541	5838	6134	6430	6726	7022	
7	7317	7613	7908	8203	8497	8792	9086	9380	9674	9968	
8		170555			171434						
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9	3186	3478	3769	4060	4351	4641	4932	5222	5512	5802	29.
150	176091	176381	176670	176959	177248	177536	177895	178113	178401	178680	28
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2		182129		182700	2085	3270	3555	3839	4123		
3	4691	4975	5259	5542	5825	6108	6391	6674	6956	7239	
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4		7803	8084	8366	8647	8928	9209	9490		190051	
5		190612		191171		191730		192289		2846	
6	3125	3403	3681	3959	4237	4514	4792	5069	5346		
7	5900	6176	6453	6729	7005	7281	7556	7832	8107	8382	
8				9481	9755	200029	200303	200577	200850	201124	27
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1	6826	7096	7365	7634	7904	8173	8441	8710	8979	9247	269
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170	230449	230704	230960			231724	231979	232234			255
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5	3038	3286	3534	3782	4030	4277	4525	4772	5019	5266	248
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7	7973	8219	8464	8709	8954	9198	9443	9687	9932	250176	
8	250420	250664	250908	251151	25 1395	251638	251881	252125	252368	2610	
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					256237	256477	256718	256958	257198		241
1 2	7679 260071	7918	8158	8398	8637	8877	9116	9355	9594	9833	
				260787		261263	261501		261976	262214	238
3	2451	2688	2925	3162	3399	3636	3873	4109	4346	4582	
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5	7172	7406	7641	7875	8110	8344	8578	8812	9046	9279	234
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7		272074		2538	2770	3001	3233	3464	3696	3927	239
8	4158	4389	4620	4850	5081	5311	5542	5772	6002	6232	230
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			3753	3979	4205	4431	4656	4882	5107	5332	
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4	7802	8026	8249	8473	8696	8920	9143	9366	9539	9812	
5	290035	290257		29 0702		291147	29 1369	291591	291813	292034	
6	2256	2478	2 699	2920	3141	3363	3584	3804	4025	4246	
7	4466	4687	4907	5127	5347	5567	5787	6007	6226	6446	220
8	6665	6884	7104	7323	7542	7761	7979	8198	8416	8635	219
9	8853	9071	9289	9507	9725	9943	300161	300378	300595	300813	218
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2	5351	3412 5566	3628 5781	3844	4059	4275	4491	4706	4921	5136	
3	7496	7710	7924	5 996	6211	6425	6639	6854	7068	7282	
	9630			8137	8351	8564	8778	8991	9204	9417	
4	9030 311754		310056			310693	310906	311118	311330	311542	
5		311966	2177	2389	2600	2812	3023	3234	3445	3656	
6	3867	4078	4289	4499	4710	4920	5130	5340	5551	5760	
7	5970	6180	6390	6599	6809	7018	7227	7436	7646	7854	
8	8063	8272	8481	8689	8898	9106	9314	9522	9730	9938	
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210	322219	322426	322633	322839	323046	323252	323458	300000	323871	324077	201
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4						331427	331630		2034	2236	
	2438	2640	2842	3044	3246	3447	3649	3850	4051	4253	
5		4655	4856	5057	5257	5458	5658	5859	6059	6260	20
6	4454										
6 7	6460	6660	6860	7060	7260	7459	7659	7858	8058	8257	
6 7 8	6460 8456	6660 8656	6860 8855	9054	9253	9451	9650	9849	340047	8257 34 0246	199
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2	6353 8305	6549 8500	6744 8694	8939 8889	7135	7330	7525	7720	7915	8110	195
			350636		9083	9278	9472	9666 351603	9600	350054 1989	194
- 3	2183	2375	2568	9761	2954	3147	3339	3532	351796 3724	1969	122
6	4108	4301	4493	4685	4876	5068	5260	5452 5452	5643	3916 5834	
7	6026	6217	6408	6599	6790	6981	7172	7363	7554	7744	
8	7935	8125	8316	8506	8696	8886	9076	9266	9456	9646	
ğ	9835	360025		360404	360593	360783	360972	361161	361350	361539	189
230	361728	361917	362105	362294	362482	362671	362859	363048	363236	363424	188
1	3612	3800	3988	4176	4363	4551	4739	4926	5113	5301	
2	5488	5675	5862	6049	6236	6423	6610	6796	6983	7169	
3	7356	7542	7729	7915	8101	8287	8473	8659	8845	9030	
4	9216	9401	9587	9772	9958	370143		370513	370698	370883	185
		371253		371622		1991	2175	2360	2544	2728	
6	2912	3096	3280	3464	3647	3831	4015	4198	4382	4565	
7	4748	4932	5115	5298	5481	5664	5846	6029	6212	6394	183
8	6577	6759	6942	7124	7306	7488	7670	7852	8034	8216	
9	8398	8580	8761	8943	9124	9306	9487	9668		380030	
	380211	380392		380754	380934	381115				381837	
1	2017 3815	2197 3995	2377 4174	2557 4353	2737	2917	3097	3277	3456	3636	
2	5606	5785	5964	4353 6142	4533	4712	4891	5070	5249	5428	
4	7390	7568	7746	7143	6321 8101	6499 8279	6677 8456	6856 8634	7034	7212	
5	9166	9343	9520	9698					8811	8989 390759	1/0
6	300035		391288	301464	301641	1817	1993	2169	2345	2521	
7	2697	2873	3048	3224	3400	3575	3751	3926	4101	4277	
8	4452	4627	4802	4977	5152	5326	5501	5676	5850	6025	
ğ	6199	6374	6548	6722	6896	7071	7245	7419	7592	7766	
250	397940	398114	398287	398461	398634	398808	398981	399154	399328	399501	173
1	9674	9847	400020	400192	400365	400538	400711	400883		401228	
	401401		1745	1917	2089	2261	2433	2605	2777	2949	
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4	4834	5005	5176	5346	5517	5688	5858	6029	6199	6370	171
5	6540	6710	6881	7051	7221	7391	7561	7731	7901	8070	
6	8240	8410	8579	8749	8918	9087	9257	9426	9595	9764	
7	9933	410102		410440	410609	410777	410946		411283	411451	169
8	411620 3300	1788 3467	1956 3635	2124 3803	2293	2461	2629	2796	2964	3132	
- 1					3970	4137	4305	4472	4639	4806	
260	414973			415474			415974	416141		416474	
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2	8301	8467	8633	8798	8964	9129	9295	9460	9625	9791	165
3	9956		420286			420781				421439	165
	421604	1768	1933 3574	2097	2261	2426	2590	2754	2918	3082	104
5	3246 4990	3410 5045	5208	3737 5271	3901	4065 5697	4228	4392	4555	4718	
?	4882 6511	5045 6674	6836	5371 6999	5534 7161	7324	5860 7486	6023 7648	6186 7811	6349 7973	103
8	8135	8297	8459	8621	8783	8944	9106	9268	9429	7973 9591	160
9	9752					430559	430720	430881	431042	431203	161
- 1	431364	431525	431685		20000	432167	432328				
2/0	431364 2969	3130	3290	431846				432488	432649	432809	
2	4569	4729	3290 4888	3450 5048	3610 5007	3770 5367	3930 5526	4090	4249	4409	100
3	4509 6163	6322	6481	6640	5207 6799	6957	5526 7116	5685 7075	5844	6004	
4	7751	7900	8067	8226	8384	8542	8701	7275 8859	7433 9017	7592 9175	
5	9333	9491	9648	9806	9964	440122	440279				
6	440909		441224			1695	1852	2009	2166	440752 2323	157
7	2489	2637	2793		3106	3263	3419	3576	3732	3889	
8	4045	4201	4357	4513	4669	4825	4981	5137	5293	5449	158
	5604				6226	6382	6537	6692	6848		
9											

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380	447158		447468		447778				448397	448552	
1	8706	8961	9015	9170	9324	9478	9633	9787	3041	450005	
2	450249	450403	450557		450865	451018	451179	451326	451479	1633	
3	1786	1940	2093	2247	2400	2553	2706	2859	3012	3165	
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5	4845 6366	4997	5150	5302	5454	5606	5758	5910	6062	6214	
6		6518	6670	6821	6973	7125	7276	7428	7579	7731	
7	7882	8033	8184	8336 9845	8487	8638	8769	8940	9091	9242	
8	9392 460698	9543	9694		9995	460146	460296	460447 1948	2098	460748 2248	
y	-,7		461198	461348	461499	1649	1799	1940		2240	130
29 0	462398		462697	462847	462997	463146	463296	463445	463594	463744	
1	3 893	4042	4191	4340	4490	4639	4788	4936	5065	5234	149
2	5383	5532	5680	5829	5977	6126	6274	6423	6571	6719	
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4	8347	8495	8643	8790	8938	9085	9233	9380	9527	9675	148
5	9822	9969	470116	470263	470410	470557	470704	470851	470998	471145	147
6	471292	471438	1585	1732	1878	2025	2171	2318	2464	2610	146
7	2756	2903	3049	3195	3341	3487	3633	3779	3925	4071	146
8	4216	4362	4508	4653	4799	4944	5090	5235	53 81	5526	146
9	5671	5816	5962	6107	6252	6397	6542	6687	6832	6976	145
200	477121	477266	477411	477555	477700	477844	477989	478133	478278	478422	145
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ğ	480007	480151	480294	480438	480582	480725	480869	481012	481156	481299	
3	1443	1586	1729	1872	2016	2159	2302	2445	2588	2731	
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5	4300	4442	4585	4727	4869	5011	5153	5295	5437	5579	
6	5721	5863	6005	6147	6289	6430	6572	6714	6855	6997	
7	7138	7280	7421	7563			7986	8127	8269	8410	
8	8551	8692	8833	8074	7704	7845 9255	9396	9537	9677	9813	
9	9958	490099	490239	490380	9114 490520	400001				491222	130
y						400001					
310	491362	491502	491642	491782	491922	492062	492201	492341	492481	492621	
1	2760	2000	3040	3179	33 19	3458	3597	3737	3876	4015	
2	4155	4294	4433	4572	4711	4850	4989	5128	5267	5406	
3	5544	5683	5822	5960	6099	6238	6376	6515	6653	6791	
4	6930	7068	7206	7344	7483	7621	7759	7897	8035	8173	
5	8311	8148	8586	8724	8862	8999	9137	9275	9412	9550	
6	9687	9824	9962		500236	500374		500648		500922	
7	501059	501196	501333	1470	1607	1744	1880	2017	2154	2291	
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9	3791	3927	4063	4199	4335	4471	4607	4743	4878	5014	136
390	505150	505286	505421	505557	505693	505828	505964	506099	506234	506370	136
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2	7856	7991	8126	8260	8395	8530	8664	8799	8934	9068	
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4	510545		510813		511081	511215	1349	1482	1616	1750	
5	1883	2017	2151	2284	2418	2551	2684	2818	2051	3084	
6	3218	3351	3484	3617	3750	3883	4016	4149	4282	4415	133
7	4548	4681	4813	4946	5079	5211	5344	5476	5609	5741	
8	5874	6006	6139	6271	6403	6535	6668	6800	6932	7064	132
9	7196	7328	7460	7592	7724	7855	7987	8119	8251	8382	
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330		518646				519171	519303	519434		519697	
1	9828			320221						521007	
	521138	521269	1400	1530	1661	1792	1922	2053	2183	2314	
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4	3746	3876	4006	4136	4266	4396	4526	4656	4785	4915	130
5	5045	5174	5304	5434	5563	5693	5822	5951	6081	6210	
6	6339	6469	6598	6727	6856	6985	7114	7243	7372	7501	
7	7630	7759	7888	8016	8145	8274	8402	8531	8660	8788	
8	8917	9045	9174	9302	9430	9559	9687	9815	9943	530072	
9	530200	530328	530456	530584	530712	530840	530968	531096	531223	1351	128
		1	1 2	3	4	5	6	7	8	9	

Na.	0	1	28	3	4	5	6	7	8	9	Diff
340	531479	531607	531734	531862	531990		532245	532372	532500	532627	128
1	2754	2882	3009	3136	3264	3391	3518	3645	3772	3899	127
2	4026	4153	4280	4407	4534	4661	4787	4914	5041	5167	127
3	5294	5421	5547	5674	5800	5927	6053	6180	6306	6432	126
4	6558	6685	6811	6937	7063	7189	7315	7441	7567	7693	
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6	9076	9202	9327	9452	9578	9703	9829	9954	540079	540204	125
7	540329		540500			540955	541080		1330	1454	
ė	1579	1704	1829	1953	2078	2203	2327	2452	2576	2701	125
9	2825	2950	3074	3199	3323	3447	3571	3696	3820	3944	194
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350	544068	544192	544 316	544440		544688			545060	545183	
1	5307	5431	5555	5678	5802	5925	6049	6172	6296	6419	
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3	7775	7898	8021	8144	8267	8389	8512	8635	8758	8881	123
4	9003	9126	9249	9371	9494	9616	9739	9861	9984	550106	123
5	550228		550473		550717			551084		1328	
6	1450	1572	1694	1816	1938	2060	2181	2303	2425	2547	
7	2668	2790	2911	3033	3155	3276	3398	3519	3640	3762	
8	3883	4004	4126	4247	4368	4489	4610	4731	4852	4973	
9	5094	5215	5336	5457	5578	5699	5820	5940	6061	6182	
9				3434							
360	556303	556423	556544	556664	556785	556905	557026	557146	557267	557387	120
1	7507	7627	7748	7868	7988	8108	8228	8349	8469	8589	120
2	8709	8829	8948	9068	9188	9308	9428	9548	9667	9787	120
3		560026				560504	560624		560863		
4	561101	1221	1340	1459	1578	1698	1817	1936	2055	2174	
5	2293	2412	2531	2650	2769	2887	3006	3125	3244	3362	
6	3481	3600	3718	3837	3955	4074	4192	4311	4429	4548	
7						5257	5376	5494	5612		
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8	5848	5966	6084	6202	6320	6437	6555	6673	6791	6909	
9	7026	7144	7262	7379	7497	7614	7732	7849	7967	8084	119
370	568202	568319	568436	568554	568671	568788	568905	569023	569140	569257	117
3.0	9374	9491	9608	9725	9842	9959				570426	
2	570543		570776		571010		1243	1359	1476	1592	
3	1709	1825	1942	2058	2174	2291	2407	2523	2639	1384	116
			3104	3220	3336	3452	3568	3684	3800	2755 3915	110
4	2872	2988								3913	110
5	4031	4147	4263	4379	4494	4610	4726	4841	4957	5072	
6	5138	5303	5419	5534	5650	5765	5880	5996	6111	6226	
7	6341	6457	6572	6687	6802	6917	7032	7147	7262	7377	115
8	7492	7607	7722	7836	7951	8066	8181	8295	8410	8525	
9	8639	8754	8868	8983	9097	9212	9326	9441	9555	9669	114
380	579784	570000	580012	580126	580241	580355	580469	590592	580697	580811	114
		581039	1153		1381	1495		1722	1836	1950	
1				1267			1608				
2	2063	2177	2291	2404	2518	2631	2745	2858	29:2	3085	
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4	4331	4444	4557	4670	4783	4896	5009	5122	5235	5348	113
5	5461	5574	5686	5799	5912	6024	6137	6250	6362	6475	
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7	7711	7823	7935	8047	8160	8272	8384	8496	8608	8720	112
8	8832	8944	9056	9167	9279	9391	9503	9615	9726	9838	
9	9950		590173	590284	590396	590507	590619	590730	590842	590953	112
-			1	1							1
3 90	591065	591176		591399		591621	591732		591955	592066	
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2	3286	3397	3508	3618	3729	3840	3 950	4061	4171	4282	
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4	5496	5606	5717	5827	5937	6047	6157	6267	6377	6487	
5	6597	6707	6817	6927	7037	7146	7256	7366	7476	7586	110
6	7695	7805	7914	8024	8134		8353	8462	8572	8681	110
7	8791	8900	9009	9119	9228		9446	9556	9665	9774	
á	9883		600101		€00319					600864	
	600973		1191	1299	14.8		1625	1734		1951	
y	10003.3	100100%	Intral	l Traila	140	1011	1020	1134	1049	1901	100

No.	0	1 1	23	3	4	5	6	1 7	8	9	Diff.
400	602060			602386	602494	602603	602711	602819	602928	603036	
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2	4226	4334	4442	4550	4658	4766	4874	4982	5089	5197	108
3	5305	5413	5521	5628	5736	5844	5951	6059	6166	6274	
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5	7455 8526	7562 8633	7669	7777	7884	7991	8098	8205	8312	8419	
7	9594	9701	9740 9808	8847 9914	8954	9061	9167	9274	9381	9488	
	610660		610873		610021 1086	1192	610234 1298	610341	610447	610554	107
9	1723	1829	1936	2042	2148	2254	2360	1405 2466	1511	1617	106
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	612784		612996			613313		613525		613736	106
1	3842	3947	4053	4159	4264	4370	4475	4581	4686	4792	
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4	5950 7000	6055	6160	6265	6370	6476	6581	6686	6790	6895	
5	8048	7105 8153	7210 8257	7315 8362	7420	7525	7629	7734	7839	7943	
6	9093	9198	9302	9406	8466 9511	8571 9615	8676	8780	8884	8989	
		62J240		620448			9719 620760	9824	9928 620968	620032	
8	1176	1280	1384	1488	1592	1695	1799	1903	2007	1072	
ğ	2214	2318	2421	2525	2628	2732	2535	2939	3042	2110 3146	
- 1		623353									
4:20	623249			623559	623663			623973	624076	624179	
2	4282 5312	4385 5415	4488	4591	4695	4798	4901	5004	5107	5210	103
3	6340	6443	5518 6546	5621 6648	5724 6751	5827	5929	6032	6135	6238	103
4	7366	7468	7571	7673		6853	6956	7058	7161	7263	
3	8389	8491	8593	8695	7775 8797	7878 8900	7980 9002	8082 9104	8185	8287	
6	9410	9512	9613	9715	9817		630021		9206 630224	9308	
		630530		630733		63 0936	1038	1139	1241	630326	102
ė	1444	1545	1647	1748	1849	1951	2052	2153	2255	1342 2356	102
9	2457	2559	2660	2761	2862	2963	3064	3165	3266	3367	101
430		633569									
	633468 4477	4578	633670 4679	633771	633872	633973	634074	634175	634276	634376	
1 2	5484	5584	5685	4779 5785	4880 5886	4981	5081	5182	5283	5383	101
3	6488	6588	6688	6789	6889	598 6 698 9	6087 7089	6187 7189	6287	6388	
4	7490	7590	7690	7790	7890	7990	8090	8190	7290 8290	7390	
5	8489	8589	8689	8789	8888	8988	9088	9188	9287	8389 9387	
6	9486	9586	9686	9785	9885		640084	640183		640382	99
7	640481	640581		640779		640978	1077	1177	1276	1375	99
8	1474	1573	1672	1771	1871	1970	2069	2168	2267	2366	99
9	2465	2563	2662	2761	2860	2959	3058	3156	3255	3354	99
440	643453	643551	643650	643749	643847		644044				'
1	4439	4537	4636	4734	4832	4931	5029	644143 5127	614242	644340	98
2	5422	5521	5619	5717	5815	5913	6011	6110	5226 6208	5324	98
ã	6404	6502	6600	6698	6796	6894	6992	7089	7187	6306 7285	98 98
4	7383	7481	7579	7676	7774	7872	7969	8067	8165	8262	98
5	8360	8458	8555	8653	8750	8848	8945	9043	9140	9237	97
6	9335	9432	9530	9627	9724	9821	9919	650016	650113	650210	97
	650308	650405	650502	650599		650793	650890	0987	1084	1181	97
8	1278	1375	1472	1569	1666	1762	1859	1956	2053	2150	97
9	2246	2343	2440	2536	2633	2730	2826	2023	3019	3116	97
450	653213	653309	653405	653502	653 598	653695	653791	653888			
1	4177	4273	4369	4465	4562	4658	4754	4850	653984 4946	654080	96 96
2	5138	5235	5331	5427	5523	5619	5715	5810	4940 5906	5042 6002	96
2	6008	6194		6386	6482	6577	6673	6769	6864	6960	96
4	7056	7152	6290 7247	7343	7438	7534	7629	7725	7820	7916	96
5	8011	8107	8202	8298	8393	8488	8584	8679	8774	8870	95
6	8965	9060	9155	9250	9346	9441	9536	9631	9726	9821	95
7	9916		660106			660391			660676	660771	95
8	660865	0960	1055	1150	1245	1339	1434	1529	1623	1718	95
9	1813	1907	2002	2396	2191	2286	2380	2475	2569	2663	95

No.	0	1	8	3	4	5	6	7	8	9	Diff
460		662852				663230					94
1	3701	3795	3889	3983	4078	4172	4966	4360	4454	4548	94
2	4642	4736	4830 5769	4924 5862	5018 5956	5112 6050	5206	5299 6237	5393	5487 6424	94
3 4	5581 6518	5675 6612	6705	6799	6892	6986	6143 7079	7173	6331 7266	7360	94
5	7453	7546	7640	7733	7826	7920	8013	8106	8199	8293	93
6	8386	8479	8572	8665	8759	8852	8945	9038	9131	9224	93 (
7	9317	9410	9503	9596	9689	9782	9875	9967	670060		93
8	670246	670339		670524		670710			0988	1080	93 (
9	1173	1265	1358	1451	1543	1636	1728	1821	1913	2005	93 9
470	672098	672190	672283	672375	672467	672560	672652	672744	672836	672929	92
1	3021	3113	3205	3297	3390	3482	3574	3666	3758	3850	92
2	3942	4034	4126	4218	4310	4402	4494	4586	4677	4760	92
3	4861	4953	5045	5137	5228	5320	5412	5503	5595	5687	92
4	5778	5870	5962	6053	6145	6236	6328	6419	6511	6602	92
5	6694	6785	6876	6968	7050	7151	7242	7333	7424	7516 8427	91
6	7607	7698 8609	7789 8700	7881	7972 8882	8063 8973	8154	8245	8336	9337	91
8	8518 9428	9519	9610	8791 9700	9791	9882	9064	9155 680063	9246 680154		91 91
9	680336		680517	680607		680789	680879	0970		1151	91
, -											
480	681241	681332 2235	681422 2326	681513 2416	681603 2506	681693 2596	681784 2686	681874 2777	681964	682055 2957	90
1 2	2145 3047	3137	3227	3317	3407	3497	3587	3677	2867 3767	3857	90 (
3	3947	4037	4127	4217	4307	4396	4486	4576	4666	4756	90
4	4845	4935	5025	5114	5204	5294	5383	5473	5563	5652	90 6
5		5831	5921	6010	6100	6189	6279	6368	6458	6547	89
6	6636	6726	6815	6904	6994	7083	7172	7261	7351	7440	89
7	7529	7618	7707	7796	7886	7975	8064	8153	8242		89
8 (8420	8509	8598	8687	8776	8865	8953	9042	9131	9220	89
9	9309	9398	9486	9575	9664	9753	9841	9930	690019	690107	89 (
490	690196	690285	690373	690462	690550	690639	690728	690816	690905	690993	89
₹ĭ	1081	1170	1258	1347	1435	1524	1612	1700			88
(2	1965	2053	2142	2230	2318	2406	2494	2583	2671	2759	88
(3		2935	3023	3111	3199	3287	3375	3463	3551	3639	88
{ 4		38 15	3903	3991	4078	4166	4254	4342	4430		88
(5			4781	4868	4956	5044	5131	5219	5307	5394	88
∫ 6		5569	5657	5744	5832	5919	6007	6094	6182		87
5 7			6531	6618	6706	6793	6880		7055		87
(8 9			7404 8275	7491 8362	7578 8449	7665 8535	7752 8622		79:26 8796		87
) -					1						87
500			699144	699231	699317	690404					87
Į į	9838		700011					700444			87
∂ 2			0877	0963	1050		1222				86
3		1654 2517	1741 2603	1827 2689	1913 2775		2086 2947				86 86
5		3377	3463				3807	3893			86
6		4236	4322		4494						
Śž											
} ė	5864								6547	6632	
) 9	6718	6803	6888			7144					85
510	707570	707655	707740	707826	707911	707996	706081	708166	708251	708336	85
ì											
∂ ĝ											85
. ã											
4	0963	1048	1132	1217		1385	1470	1554	1639	1723	84
< 5						2229	2313				
⟨ ₫											
7 ک											
(8					4665						
<u> </u>	5167	5251	5335	5418	55.2	5586	5669	5753	5836	5920	84
No.	0	1.1	2	3	4	5	6	7	8	9	Diff

Na			8								Diff
520	716003	716087	716170				716504				83
1	6838	6921	7004	7088	7171	7254	7338	7421	7504	7587	83
2	7671	7754	7837	7920	8003	8086	8169	8253	8336	8419	83
3	8502	8585	8668	8751	8834	8917	9000	9063	9165	9248	83
4	9331	9414	9497	9580	9663	9745 720573	9828	9911	9994 720821	720077	83
	720159	1068	720325	720407 1233	720490		720655	720738	1646	0903	83 82
6	0986	1893	1151 1975	2058	1316	1398 2222	1481 2305	1563 2387	2469	1728 2552	82
7	1811			2881	2140 2963	3045	3127	3209	3291	3374	82
8	2634 3456	2716 3538	2798 3620	3702	3784	3866	3948	4030	4112	4194	82
9											
530	724276	724358		724522	724604	724685	724767	724849	724931	725013	82
1	5095	5176	5258	5340	5422	5503	5585	5667	5748	5830	82
2	5912	5993	6075	6156	6238	6320	6401	6483	6564	6646	82
3	6727	6809	6890	6972	7053	7134	7216	7297	7379	7460	81
4	7541	7623	7701	7785	7866	7948	8029	8110	8191	8273	81
5	\$354 9165	8433	8516	8597	8678	8759	8841	8922	9003	9084	81
6		9246	9327	9408	9489	9570	9651	9732	9813	9893	81
7	9974	730055			730298		730459	730540	730621	730702	81
	730782	0863	0944	1024	1105	1186	1266	1347	1428	1508	81
8	158)	1669	1750	1830	1911	1991	2072	2152	2233	2313	81
540	732394	732474	732555	732635	732715	732796	732876	732956	733037	733117	80
1	3197	3278	3358	3438	3518	3598	3679	3759	3839	3919	80
ĝ	3999	4079	4160	4240	4320	4400	4480	4560	4640	4720	80
3	4800	4880	4960	5040	5120	5200	5279	5359	5439	5519	80
4	5599	5679	5759	5833	5918	5998	6078	6157	6237	6317	80
5	6397	6476	6556	6635	6715	6795	6874	6954	7034	7113	80
6	7193	7272	7352	7431	7511	7590	7670	7749	7829	7908	79
7	7987	8067	8146	8225	8305	8384	8463	8543	8622	8701	79
8	8781	8860	8939	9018	9097	9177	9256	9335	9414	9493	79
9	9572	9651	9731	9810	9889	9968	740047	740126	740205	740284	79
550	740363	740442	740521	740600	740678	740757	740836	740915	740994	741073	79
330	1152	1230	1309	1388	1467	1546	1624	1703	1782	1860	79
2	1939	2018	2096	2175	2254	2332	2411	2489	2568	2647	79
3	2725	2804	2882	2961	3039	3118	3196	3275	3353	3431	78
4	3510	3588	3667	3745	3823	3902	3980	4058	4136	4215	78
5	4293	4371	4449	4528	4606	4684	4762	4840	4919	4997	78
6	5075	5153	5231	5309	5387	5465	5543	5621	5699	5777	78
7	5855	5933	6011	6089	6167		6323	6401	6479	6556	78
ė	6634	6712	6790	6868	6945		7101	7179	7256	7334	78
ğ	7412	7489	7567	7645	7722	7800	7878	7955	8033	8110	78
	***			ı	#40.400		#400F0		***		
	748188	748266		748421	748498	748576	748653	748731	748808	748885	77
1	8963	9040	9118	9195	9272	9350	9427 750200	9504	9582	9659	77
2	9736 750508	9814 750586	9891	9968 750740		750123 0894	0971	750277 1048	750354 1125	750431 1202	77
	1279	1356	750663		0817 1587	1664	1741	1818	1125	1972	77
5	2048	2125	1433 2202	1510 2279	2356	2433	2509	2586	2663	2740	77
6	2816	2893	2970	3047	3123	3200	3277	3353	3430	3506	77
7	3583	3660	3736	3813	3889	3966	4042	4119	4195	4272	77
8	4348	4425	4501	4578	4654	4730	4807	4883	4960	5036	76
9	5112	5189	5265	5341	5417	5494	5570	5646	5722	5799	76
- 1	_	i									
	755875	755951	756027	756103	756180	756256	756332	756408	756484	756560	76
1	6636	6712	6788	6864	6940	7016	7092	7168	7244	7320	76
2	7396	7472	7548	7624	7700	7775	7851	7927	8003	8079	76
3	8155	8230	8306	8382	8458	8533	8609	8685	8761	8836	76
	8912	8988	9063	9139	9214	9290	9366	9441	9517	9592	76
4	0.000	9743	9819	9894	9970	760045	760121	760196		760347	75
5	9668				760704	0799	0875	0950	1025	1101	75
5 6	760422	760498									
5 6 7	760422 1176	1251	1326	1402	1477	1552	1627	1702	1778	1853	75
5 6 7 8	760422 1176 1928	1251 2003	1326 2078	1402 2153	1477 2228	1552 2303	1627 2378	1702 2453	1778 2529	1853 2604	75 75
5 6 7	760422 1176	1251	1326 2078	1402 2153	1477	1552	1627	1702	1778	1853	75

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700	1845096	845160	845222	845284	845346	845408	1845470	1845539	845594	1845656	1 62	₹
ίï	5718											(
(\$	6337	6399	6461			6646	6708			6894	62	(
7 3	6955	7017	7079	7141	7202	7264	7326	7388	7449	7511	62	(
λ 4	7573	7634	7696	7758		7881	7943	8004	8066	8128	62	(
∂ 5			8312	8374		8497	8559					(
λ 6				8989	9051	9112	9174	9235				۲
7			9542				9788	9849				(
(8	850033			850217		850340	850401	850462	850524	850585	61	(
(8	0646	0707	0769	0830	0691	0952	1014	1075	1136	1197	61	(
\$ 710	851258	851320	851381	851442	851503	851564	851625	851686	851747	851809	61	(
ζ'n			1992		2114	2175		2297	2358			{
(ĝ					2724				2968			<
√ ã				3272	3333			3516		3637	61	(
\ 4				3881	3941	4002		4124			61	Ç
<u>ر</u> 5			4428	4488	4549	4610		4731	4792		61	۲
⟨ĕ		4974	5034	5095	5156	5216	5277	5337	5398	5459	61	١
ζĩ	5519	5580	5640	5701	5761	5822	5882	5943	6003	6064	6i	١
ζė			6245	6306	6366	6427	6487	6548	6608		GO	١
ζĝ	6729	6789	6850	6910	6970	7031	7091	7152	7212	7272	60	۶
720	857220	857393	OK74F2	857513	957574	857634	957804	857755	857815	857875	60	١
(120	7935			8116	8176	8236	8297	8357	8417	8477	60	١
Ś		8597	8657	8718	8778	8838	8898	8958	9018	9078	60	١
Sã			9258	9318	9379	9439	9499	9559	9619		60	١
(4			9859	9918	9978					860278	60	'n
5		860398				0637	0697	0757	0817	0877	60	١
Šě		0996	1056	1116	1176	1236	1295	1355	1415	1475	60	>
) 7		1594	1654	1714	1773	1833	1893	1952	2012	2072	60	ì
S è		2191	2251	2310	2370	2430	2489	2549	2608	2668	60	ì
ۋ (2728	2787	2847	2906	2966	3025	3085	3144	3204	3263	60	2
730	863323	863382	863442	863501	863561	General	863680	000000	863799	863858	50	2
130	3917	3977	4036	4096	4155	4214	4274	863739 4333	4392		59	l
(2		4570	4630	4689	4748	4808	4867	4926	4985	5045	59	l
} ã		5163	5222	5282	5341	5400	5459	5519	5578	5637	59	l
₹ 4		5755	5814	5874	5933	5992	6051	6110	6169	6228	59	(
5		6346	6405	6465	6524	6583	6642	6701	6760	6819	59	(
≀ ŏ		6937	6996	7055	7114	7173	7232	7291	7350	7409	59	(
7	7467	7526	7585	7644	7703	7762	7821	7880	7939	7998	59	(
} ė́	8056	8115	8174	8233	8292	8350	8409	8468	8527	8586	59	(
وَم		8703	8762	8821	8879	8938	8997	9056	9114	9173	59	(
740	869232	869290		869408	869466	869525	869584	869642	869701	869760	59	(
140	9818	9877	9935						870287	870345	59	ſ
₹ 2	370404	870462	870521	870579	0638	0696	0755	0813	0872	0930	58	ſ
ζã	0989	1047	1106	1164	1223	1281	1339	1398	1456	1515	58	S
₹ 4	1573	1631	1690	1748	1806	1865	1923	1981	2040	2098	58	ţ
5	2156	2215	2273	2331	2389	2448	2506	2564	2622	2681	58	,
6	2739	2797	2855	2913	2972	3030	3088	3146	3204	3262	58	١
ζž	3321	3379	3437	3495	3553	3611	3669	3727	3785	3844	58	5
Ś ė	3902	3960	4018	4076	4134	4192	4250	4308	4366	4424	58	5
(j	4482	4540	4598	4656	4714	4772	4930	4888	4945	5003	58	١
750	975061	875119	1	- 1	875293	975251	875409		875524	875582	58	'n
130	5640	5698	5756	5813	5871	5929		6045	6102	6160	58)
2	6218	6276	6333	6391	6449	6507	5987 6564	6622	6680	6737	58)
วั	6795	6853	6910	6968	7026	7083	7141	7199	7256	7314	58	1
4	7371	7429	7487	7544	7602	7659	7717	7774	7832	7889	58	
5	7947	8004	8062	8119	8177	8234	8292	8349	8407	8464	57	i
6	8522	8579	8637	8694	8752	8809	8866	8924	8981	9039	57	,
7	9096	9153	9211	9268	9325	9383	9440	9497	9555	9612	57)
8	9669	9726	9784	9841	9898				880127		57	,
9	880242						0585	0642	0699	0756	57 ?	j
No.			2	3	4	5	6	7	8	9 1	Diff.	
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₹No.	~~~	\sim	~ <u>~</u> ~~	ĭ~3 ~	~ ~ ~	~ ` `	76 ~	~~~	8	(9)	Diff.
760	880814		880J28	880985	881042	881099	881156	881213		881328	57
{ } 2	1385 1955	1442 2012	1499 2069	1556 2126	1613 2183	1070 2240	1727 2297	1784 2354	1841 2411	1898 2468	57 (
} 3ੌ	2525	2581	2638	2695	2752	2809	2866	2923	2980	3037	57 (
₹ 4	3093	3150	3207	3264	3321	3377	3434	3491	3548	3605	57 (
5 6	3661 4229	3718 4285	3775 4342	3832 4399	3888 4455	3945 4512	4002 4569	4059 4625	4115 4682	4172 4739	57 (57 (
) 7	4795	4852	4909	4965	5022	5078	5135	5192	5248	5305	57
} 8	5361	5418	5474	5531	5587	5644	5700	5757	5813	5870	57 (
} 9	5926	5983	6039	6096	6152	6209	6265	6321	6378	6434	56 (
770	886491	886547	886904	886660	886716	886773	886829	886885	886042	886998	56 2
\ 1 2	7054 7617	7111 7674	7167 7730	7223 7786	7280 7842	7336 7898	7392 7955	7449 8011	7505 8067	7561 8123	56) 56)
₹ã	8179	8236	8292	8348	8404	8460	8516	8573	8629	8685	56
∫ 4	8741	8797	8853	8909	8965	9021	9077	9134	9190	9246	56 >
{ 5 6	9302	9358	9414	9470	9526 890086	9582 890141	9633	9694 890253	9750 890309	9806 890365	56 } 56 }
2 7	9862 890421	9918 890477	9974 890533	890039 0589	9645	0700	890197 0756	0812	0868	0924	56
(8	0980	1035	1091	1147	1203	1259	1314	1370	1426	1482	56 >
('9	1537	1593	1649	1705	1760	1812	1872	1928	1,483	2039	56 >
780	892095	892150	892206	892262	892317	892373	892429	892484	892540	892595	56 /
1 2	9651 3207	2707 3202	2762 3318	2818 3373	2873 3429	2929 3484	2985 3540	3040 3595	3096 3651	3151 3706	56 (56 (
3	3769	3817	3873	3928	3984	4039	4094	4150	4205	4261	55 \
4	4316	4371	4427	4482	4538	4593	4648	4704	4759	4814	55 (
5 6	4870 5423	4925 5478	4980 5533	5036 5588	5091 5644	5146 5699	5201 5754	5257 5809	5312 5864	5367 5920	55 (55 (
ζ,	5975	6030	6065	6140	6195	6251	6306	6361	6416	6471	55 (
S è	6526	6581	6636	6692	6747	6802	6857	6912	6967	7022	55 (
9	7077	7132	7187	7242	7297	7352	7407	7462	7517	7572	55 5
790	897627	897682	897737	897792	897847	807902	897957	898012	898067	898122	55 2
2 2	8176 8725	8231	8286 8835	8341 8890	8396 8944	8451 8999	8506 9054	8561 9109	8615 9164	8670 9218	55 \ 55 \
3	9273	8780 9328	9383	9437	9492	9547	9602	9656	9711	9766	55)
4	9821	9875	9930	9935	900039	900094	900149	900203	900258	900312	55 >
5		900422	900476	900531	0586	0640 1186	0695	0749	0804 1349	0859 1404	55 } 55 }
6	0913 1458	0968 1513	1022 1567	1077 1622	1131 1676	1731	1240 1785	1295 1840	1894	1948	54 5
è š	2003	2057	2112	2166	2221	2275	2329	2384	2438	2492	54 >
9	2547	2601	2655	2710	2764	2818	2873	2927	2981	3036	54)
800	903090	903144	903199	903253	903307	903361	903416	903470	903524	903578	54 5
1 2	3633 4174	3687 4229	3741 4283	3795 4337	3849 4391	3904 4445	3958 4499	4012 4553	4066 4607	4120 4661	54 S
\ 3	4716	4770	4824	4878	4391	4986 4986	5040	4553 5094	5148	5202	54 \
4	5256	5310	5364	5418	5472	5526	5580	5634	5688	5742	54 (
5	5796	5850	5904	5958 6497	6012 6551	6066	6119	6173	6227 6766	6281 6820	54 { 54 {
67	6333 6874	6389 6927	6443 6981	7035	7089	6604 7143	6658 7196	6712 7250	7304	7358	54 (
⟨ 8	7411	7465	7519	7573	7626	7680	7734	7787	7841	7895	54 🕻
9	7949	8002	8056	8110	8163	8217	8270	8324	8378	8431	54 5
810	908485	908539	908592	908646	908699	908753	908807	908860	908914	908967	54 2
1 2	9021 9556	9074 9610	9128 9663	9181 9716	9235 9770	9289 9823	9342 9877	9396 9930	9449 9984	9503 910037	54 >
3	9330 910091	910144	9003 910197	910251	910304	910358	910411	910464	910518	0571	53)
4	0624	0678	0731	0784	0838	0891	0944	0998	1051	1104	53 >
5	1158	1211	1264	1317	1371	1424	1477	1530	1584	1637	53 >
6 7	1690 2222	1743 2275	1797 2328	1850 2381	1903 2435	1956 2488	2009 2541	2063 2594	2116 2647	2169 2700	53 /
8 (2753	2806	2859	2913	2966	3019	3072	3125	3178	3231	53)
9	3284	3337	3390	3443	3496	3549	3602	3655	3708	3761	53
No.	0	1	2	1_3_	4	5	6	1 7	8	9	Diff

No.	0	1	28	3	4	5	6	7	8	9	Dif
820	913814	913867	913920			914079	914132			914290	33
1	4343	4396	4449	4502	4555	4608	4660	4713	4766	4819	53
2	4872	4925	4977	5030	5083	5136	5189	5241	5294	5347	53
3	5400	5453	5505	5558	5611	5664	5716	5769	5822	5875	53
4	5927	5980	6033	6085	6138	6191	6243	6296	6349	6401	53
5	6454	6507	6559	6612	6664	6717	6770	6822	6875	6927	53
6	6980	7033	7085	7138	7190	7243	7295	7348	7400	7453	53
7	7506	7558	7611	7663	7716	7768	7820	7873	7925	7978	52
8	8030	8083	8135	8188	8240	8293	8345	8397	8450	8502	52
9	8555	8607	8659	8712	8764	8816	8869	8921	8973	9026	52
										010540	
830	919078	919130	919183		919287	919340			919496		52
1	9601	9653	9706	9758	9810	9862	9914	9967	920019		52
2	920123		920228	920280			920436		0541	0593	52
3	0645	0697	0749	0801	0853	0906	0958	1010	1062	1114	52
4	1166	1218	1270	1322	1374	1426	1478	1530	1582	1634	52
5	1686	1738	1790	1842	1894	1946	1998	2050	2102	2154	52
6	2206	2258	2310	2362	2414	2466	2518	2570	2622	2674	52
7	2725	2777	2829	2881	2933	2985	3037	3089	3140	3192	52
8	3244	3296	3348	3399	3451	3503	3555	3607	3658	3710	52
9	3762	3814	3865	3917	3969	4021	4072	4124	4176	4228	52
		~~	004202	924434	004400	204520	924589	004641	~4602	004744	52
840	924279		4899						924693 5209	924744 5261	52
1	4796	4848		4951	5003	5054	5106	5157			
2	5312	5364	5415	5467	5518	5570	5621	5673	5725	5776	52
3	5828	5879	5931	5982	6034	6085	6137	6188	6240	6291	51
4	6342	6394	6445	6497	6548	6600	6651	6702	6754	6805	51
5	6857	6908	6959	7011	7062	7114	7165	7216	7268	7319	51
6	7370	7422	7473	7524	7576	7627	7678	7730	7781	7832	51
7	7883	7935	7986	8037	8088	8140	8191	8242	8293	8345	51
8	8396	8447	8498	8549	8601	8652	8703	8754	8805	8857	51
9	8908	8959	9010	9061	9112	9163	9215	9266	9317	9368	51
050		000 480	000801	000		~~~~	00070E	929776	000007	929879	51
850	929419		929521 930032	929372	929623	929674			930338	930389	51
1	9930	9981		930083			930236	0796	0847	0898	51
2	930440		0542	0592	0643	0694	0745				51
3	0949	1000	1051	1102	1153	1204	1254	1305	1356	1407	
4	1459	1509	1560	1610	1661	1712	1763	1814	1865	1915	51
5	1966	2017	2068	2118	2169	2220	2271	2322	2372	2423	51
6	2474	2524	2575	2626	2677	2727	2778	2829	2879	2930	51
7	2981	3031	3082	3133	3183	3234	3285	3335	3386	3437	51
8	3487	3538	3589	3639	3690	3740	3791	3841	3892	3943	51
9	3993	4044	4094	4145	4195	4246	4296	4347	4397	4448	51
860	934498	200	934599	934650	934700	024751	934801	934852	934902	934953	50
		934549				934751 5255	5306	5356	5406	5457	50
1	5003	5054	5104	5154	5205					5960	50
2	5507	5558	5608	5658	5709	5759	5809	5860	5910		50
3	6011	6061	6111	6162	6212	6262	6313	6363	6413	6463	50 50
4	6514	6564	6614	6665	6715	6765	6815	6865	6916	6966	50 50
5	7016	7066	7117	7167	7217	7267	7317	7367	7418	7468	
6	7518	7568	7618	7668	7718	7769	7819	7869	7919	7969	50
7	8019	8069	8119	8169	8219	8269	8320	8370	8420	8470	
8	8520	8570	8620	8670	8720	8770	8820	8870	8920		
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870	939519	939569	020610	939669	020710	020760	939819	030860	030010	939968	50
0/U 1	940018			940168					940417		50
2							0815	0865	0915	0964	50
ž	0516	0566	0616	0666	0716	0765					50
3	1014	1064	1114	1163	1213	1263	1313	1362	1412		50 50
4	1511	1561	1611	1660	1710	1760	1809	1859	1909		
5	2008	2058	2107	2157	2207	2256	2306	2355	2405		50
6	2504	2554	2603	2653	2702	2752	2801	2851	2901	2950	
7	3000	3049	3099	3148	3198	3247	3297	3346			49
8		3544	3593	3643	3692	3742	3791	3841	3890		49
9	3989	4038	4088	4137	4186	4236	4285	4335	4384	4433	49

1 4976 5025 5074 5124 5173 5222 5272 5321 5370 2 5469 5518 5567 5616 5665 5715 5764 5613 5682 3 5061 6010 6059 6108 66157 6207 6256 6305 6354 4 6452 6501 6551 6600 6649 6688 6747 6796 6845 5 6043 6692 7041 7090 7140 7189 7238 7387 7336 6 7434 7483 7332 7351 7630 7679 7728 7777 7366 6 7434 7483 7332 7351 7630 7679 7728 7777 7896 6 7434 7483 7332 7351 7300 8168 8217 8266 8315 8 8413 8462 8511 8560 8609 8657 8706 8755 8604 9 89002 8951 8999 9048 9097 9146 9195 9244 9 9978 9996 9975 950024 950073 950121 950170 950219 950267 2 9 95055 95044 950462 0511 0560 0608 0657 0706 0757 2 9 95055 95044 950462 0511 0560 0608 0657 0706 0757 3 0651 0900 0049 0997 1046 1095 1143 1192 1240 4 1338 1386 1435 1483 1532 1530 1629 1677 1726 6 2308 2356 2405 2453 2502 2550 2599 2647 2696 8 3276 3325 3373 3421 3470 3518 3566 3615 3663 9 3760 3308 3856 3305 3953 4001 4049 4098 4146 900 954243 954291 954339 954387 954435 95448 954532 954580 95468 812 1 4725 4773 4821 4869 4913 4966 5014 5062 5110 2 2 5007 5255 5704 5635 5399 5447 5495 5543 5592 3 5688 5736 5784 5632 5880 5928 5976 6024 6072 7 7607 7655 7703 7751 7799 7787 7894 7942 7990 8 8060 8134 8181 8229 8277 8235 8373 8421 8468 9 9 360 660 613 0661 0709 0756 0694 0756 0694 4 0610 0610 0610 0610 0799 0756 0694 0606		Ĺ	1	8	3	4	5	6	1 7	8	9	Diff.
5 5469 5518 5567 5616 5665 5715 5764 5813 5862 3 3661 6010 6050 6106 6157 6207 6256 6305 6354 5 6943 6892 7041 7090 7140 7169 7238 7267 7366 6845 6 7434 7483 7352 7581 17630 7697 7728 7777 7886 8 8413 8462 8511 8500 8609 8657 7606 8715 8609 800 949399 94948 9997 9146 9195 9244 9292 2 950365 9995 9995 9906 9097 9146 9195 9244 9292 2 950365 390414 950422 95050 9060 0667 0766 0754 3 0851 1823 1872 1920 1909 2017 2066	9	194	44532	944581	944631	944680	944729	944779	944828	944877	944927	49
3 5961 6010 6059 6108 6157 6207 6256 6343 6343 6992 7041 7090 7140 7189 7238 7287 7336 6845 6747 77944 7833 7322 7581 7630 7679 7728 7727 7843 7323 7581 7630 7679 7728 7777 7836 8 413 8462 8511 8560 8609 8657 8706 8755 8604 9 8902 8953 9999 996 8975 950024 950179 950219 950365 8609 9996 9975 950024 95011 95070 950219 950279 950279 950279 950279 950279 950279 950279 950365 9975 950024 950073 950024 950077 950024 95077 950024 95077 950024 950077 950024 950077 950024 950077 950024 950077 <td< th=""><td></td><td>1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>5419</td><td>49</td></td<>		1									5419	49
4 6452 6501 6551 6600 6649 6696 6747 6796 6845 6604 67434 74433 6992 7041 7909 7140 7189 7238 7287 7736 6 7434 74433 7532 7581 7630 7679 7728 7777 7896 8 8413 8462 8511 8560 8609 8657 8766 8755 8904 9800 949390 949439 949439 949439 949439 949439 949439 949439 949439 949439 949585 949585 949634 94963 977 922 950365 85041 8599 9058 9975 950024 850073 950121 950170 950219 950267 9 950365 950414 950462 0511 0560 0606 0657 0766 0754 1333 1386 1435 1483 1532 1580 1699 1677 1726 6 2308 2356 2905 2453 2502 2550 2599 2647 2696 6 2358 3373 3421 3470 3518 3566 3615 3663 8 3276 3325 3373 3421 3470 3518 3566 3615 3663 9 3760 3808 3856 3805 3853 4001 4049 4098 4146 9 900 950 95423 95423 954239 954339 954339 954339 954435		1									5912	49
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Type		1									7385	49
8 8413 8462 8511 8560 8609 6657 8706 8755 8604 99 8009 94830 949488 949585 949634 949683 94975 950024 950073 950121 950170 950219 950267 9 9506 9975 950024 950073 950121 950170 950219 950267 9 9506 9975 950024 950073 950121 950170 950219 950267 9 95024 950073 950121 950170 950219 950267 9 95024 950073 950121 950170 950219 950267 9 95024 950073 950121 950170 950219 950267 9 95024 950073 950121 950170 950219 950267 9 95024 950073 9 9017 9506 2114 3138 1336 1435 1483 1532 1590 1629 1677 1726 6 2308 2366 2405 2453 2502 2550 2599 9647 2606 9 9675 9302 2411 2889 2308 2966 3034 3033 3131 3180 9 9 3760 3808 3856 3905 3953 4001 4049 4049 4049 9 997 9 9502 9502 9502 9502 9502 9502 9502 95		ı									7875	49
69 8002 8051 8999 9048 9097 9146 9105 9244 9292 800 949390 949389 94968 949536 949539 949639 949639 9956 99058 99058 949633 949633 949631 950219 950267 9975 95074 9507 95076 95076 950267 936 952219 950267 976 95026 9773 95026 9503 9503 1133 1133 1132 1192 1192 1294 1294 1677 1726 6 2308 2356 2405 2433 2502 2550 2599 2647 2966 6 2308 2366 3323 3373 3421 3473 3453 3461 3403 3463 3463 3463 3463 3466 3473 3483 34443 35444 466 3414 3472 3473 3483 34343 35444 3466 3414 34725 4773		ı							6200		8364	49 (
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1 9878 9986 9975 950024 950073 950121 950170 950219 950267 9 2 950365 950414 950462 0511 0560 0608 0607 0706 0754 3 0851 0900 0049 0997 1046 1095 1143 1192 1240 4 1338 1386 1435 1483 1332 1590 1629 1677 1726 5 1823 1872 1920 1969 2017 2066 2114 2163 2211 6 2308 2326 2405 2453 2502 2550 2599 2647 2696 8 3276 3325 3373 3421 3470 3518 3566 3615 3663 9 3760 3808 3856 3905 3953 4001 4049 4098 4146 9 00 554243 954291 954339 954387 954435 954484 954532 954689 8134 2470 3518 3566 3615 3663 3615 3663 3615 3663 3616 4099 4098 4146 5014 4725 4773 4821 4969 4913 4966 5014 5062 5110 5207 5255 5303 3531 3393 54484 954532 954580 95468 8 4668 6216 6255 6313 6361 6409 6457 6504 6697 6745 6793 6840 697 7675 7707 7655 7703 7751 7799 7847 7846 7942 7990 95041 95090 959137 959185 95923 959280 95928 9596 6994 7032 2 9995 960042 96090 960138 960138 960138 3650 6994 7032 1 95041 95090 959137 959185 95923 959280 95937 959375 959423 95900 95937 959185 95923 95900 95937 959185 95923 95960 9604 96038 960138 960138 960138 960138 960138 960			GROT	Cata	3030	9097	9140	8132	9244	9292	9341	49
1 9878 9986 9975 950024 950073 950121 950170 9502219 950267 950365 950414 950462 0511 0560 0668 0657 0706 0778 0706 0748	8	94	49439								949829	49
3		ĺ						950170			950316	49
1338	Ø	95						0657			0803	49
4 1338 1386 1435 1483 1332 1380 1629 1677 1736 5 1823 1872 1920 1969 90177 2066 2114 2163 2211 6 2308 2356 2405 2453 2502 2550 2599 2647 2666 2 2457 2666 2 2457 2666 2 2457 2666 2 2457 2666 2 2457 2 2457 2 2 2 2 2 2 2 2 2											1289	49
6 2908 2356 2405 2453 2502 2550 2599 2641 2689 7 2702 2841 2889 2388 2986 3034 3033 3131 3180 8 3276 3325 3373 3421 3470 3518 3566 3615 3663 990 900 954243 954391 954387 954435 954448 954520 95560 55628 5110 2 5207 5255 5303 3531 5399 5447 5495 95450 954628 95460 5014 5062 5110 5022 510 5523 5523 5533 5351 5399 5447 5495 5543 5592 4666 6666 6676 6745 6793 6613 6640 6667 66745 6793 6640 6888 6936 6944 7512 7707 7707 7751 77791 7751 7791 7751 7791 </th <td></td> <td>1</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>1775</td> <td>49</td>		1									1775	49
2702 2841 2889 2938 2986 3034 3083 3131 3180 6 3276 3325 3323 3321 3470 3518 3566 3653 3663 3663 3663 3663 3663 3663 3663 3663 3663 3663 3663 3663 3668 3672 4821 4896 5014 4049 4048 4146 4049 4098 4146 5062 5110 5062 5110 5062 5110 5062 5110 5062 5110 5062 5110 5062 5110 5062 5110 5062 5110 5062 510 510 6040 6673 6745 6733 6840 6888 6936 6940 6672 6745 6793 6840 6888 6936 6947 7024 7272 7320 7366 7416 7464 7512 7799 7847 7894 7942 7990 7947 7894 7942 <td></td> <td>1</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>2260</td> <td>48)</td>		1									2260	48)
8 3276 3285 3373 3421 3470 3518 3566 3615 5663 9 3760 3806 3805 3953 3953 4001 4049 4098 4146 900 954243 954393 954387 954435 954486 954529 954680 954680 5110 5062 5112 7076 7077 7077 7077 7077 7077 7077 70777 7078 77517		ı									2744	48
90 954243 954291 954339 954387 954435 954484 954532 954580 954686 91 4725 4773 4821 4869 4918 4966 5014 5062 5110 4725 4773 4821 4869 4918 4966 5014 5062 5110 5022 5110 5022 5207 5255 5303 5351 5399 5447 5495 5543 5592 3586 5736 5754 5552 5880 5928 5976 6024 6072 5256 533 6061 6499 6457 6505 6553 56 67 5224 72724 7272 7280 7280 7280 7464 7512 7760 7284 7272 7280 7280 7280 7464 7512 7280 7386 7416 7464 7512 7760 7655 7703 7751 7799 7847 7894 7942 7990 8564 8612 8659 8707 8755 8803 8850 8898 8046 91 98564 8612 8659 8707 8755 8803 8850 8898 8046 91 98564 8612 8659 8707 8755 8803 8850 8898 8046 91 985041 959041 95906 959137 959185 95923 959289 959375 960328 96032		ı									3228	48
900 954243 954291 954339 954387 954433 954484 954532 954580 954688 93		ı									3711	48
1		ı	3808	3856	3905	3953	4001	4049	4098	4146	4194	48
1 4725 4773 4821 4869 4918 4966 5014 5062 5110 2 5257 5255 5303 5351 5399 5447 5495 5543 5592 4 6672 5255 5303 5351 5399 5447 5495 5543 5592 4 6686 626 6265 6313 6361 6409 6457 6505 6553 6649 6697 6745 6793 6840 6888 6936 6994 7032 6 7128 7176 7224 7272 7320 7366 7416 7464 7512 7 7667 7655 7703 7751 7799 7847 7894 7992 7990 8 8066 8134 8181 8229 8277 8325 8373 8421 8468 8 8066 814 8181 8229 8277 8325 8373 8421 8468 9 8064 8012 8659 8707 8755 8803 8850 8896 8046 8094 7032 6 8004 8012 8659 8707 8755 8803 8850 8896 8046 8012 8659 8707 8755 8803 8850 8896 8046 8012 8659 8707 8755 8803 8850 8898 8046 8012 8659 8707 8755 8803 8850 8898 8046 8012 8009 90138 80185 80223 960231 960323 960333 960471 0518 0566 0613 6661 0709 0755 0604 0851 6004 0851 6004 0944 1041 1089 1136 1184 1231 1279 1326 6 1805 1943 1990 2438 2485 2432 2400 2937 2985 3032 3079 3126 3174 3221 8280 93316 3333 3410 3457 3504 3532 3599 3646 3693 9909 96388 963835 963882 963929 963977 964024 964071 96418 96416 9940 94307 4354 4401 4448 4495 4524 4599 4637 2478 4825 4872 4919 4966 5013 5014 5578 4778 4825 4872 4919 4966 5013 5014 5578 577 9806 77 2769 565 5813 5800 5807 5954 6001 6048 677 7060 7175 666 6611 6658 6705 6752 6799 6845 6892 6893 6896 9043 9009 9806 6896 9043 9009 9806 6896 9043 9009 9806 8778 9806 8835 968883 968883 963883 96383 96399 963977 964024 964071 96418 964165 9666 6611 6658 6705 6752 6799 6845 6892 6939 6896 9043 9090 9136 9183 9299 9770 7700 7756 6813 5596 6803 5007 5954 6001 6048 6777 7000 7127 7173 7320 7320 7327 7321 7361 7408 7454 9799 9709 9709 9709 9709 9709 9709 970	q	Q	54291	954339	954387	954435	954484	954539	954580	954628	954677	48 8
5 5 52907 52555 5303 53511 5399 5447 5495 5543 5592 3 5698 5736 5784 5532 5880 5928 5976 6024 6072 4 6168 6216 6265 6313 6361 6409 6457 6505 6553 6574 6582 6984 6080 6984 7002 77607 7655 7703 7751 7799 7366 7416 7464 7512 7900 8066 8134 8181 8229 8277 8235 8373 8421 8468 8421 8468 8669 8707 8755 8803 8850 8896 8046 8942 9990 89917 899185 999232 959280 98937 9990 9601 9709 9757 9804 96329 9900 960329 9900 960329 9900 960329 9900 960329 9900 960329 9900 960329 9900 960329 </th <td>_</td> <td>۳</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>5158</td> <td>48 (</td>	_	۳									5158	48 (
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6166 6216 6265 6313 6361 6409 6457 6505 6553 5 6649 6697 6745 6793 6640 6888 6936 6994 7032 6 7128 7176 7224 7272 7329 7362 7416 7464 7512 793 7 7007 7655 7703 7751 7779 7847 7894 7942 7990 8 8086 8134 8181 8229 8277 8235 8373 8421 8468 9 8564 8612 8659 8707 87518 8903 8890 8982 89946 910 95918 95060 9614 9661 9709 9757 9804 9802 9990 9 9958 960040 9601 9709 9757 9804 9802 99900 1 991 05182 141 4696 1041 1069 1136 1141 <td></td> <td>l</td> <td>5736</td> <td>5784</td> <td>5832</td> <td>5880</td> <td>5928</td> <td></td> <td>6024</td> <td>6072</td> <td>6120</td> <td>48 6</td>		l	5736	5784	5832	5880	5928		6024	6072	6120	48 6
65 6649 6667 6745 6793 6840 6888 6936 6944 7032 6 7128 7176 7224 7272 7272 7272 7272 7272 7272 7272 7272 7272 7272 7272 7280 7464 7512 7299 7847 7894 7942 7906 88 8898 8898 8898 8898 8898 8894 892 8877 8252 8373 8421 8468 8134 8181 8299 8893 8893 8893 8893 88948 8946 8994 9919 95041 9661 9661 9601 9601 96018 96023 96023 96023 96023 96023 96037 9652 9903 96021 96018 96018 96023 96023 96023 96023 96023 96027 9603 96023 96023 96023 96023 96033 96023 96023 96033 96024 9602<			6216	6265	6313	6361	6409			6553	6601	48 (
7 7607 7655 7703 7751 7799 7847 7944 7942 7900 8 8 8 8066 8134 8181 8299 8277 8255 8373 8421 8468 9 8564 8012 8659 8707 8755 8903 8850 8898 8946 8 19 8564 8012 8659 8707 8755 8903 8850 8898 8946 8 19 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8		ı	6697	6745	6793				6984	7032	7080	48
7 7607 7655 7703 7751 7799 7847 7894 7942 7990 8 8066 8134 8181 8299 8277 8235 8373 8491 8468 8468 9864 8612 8659 8707 8755 8803 8850 8896 8046 910 95041 9561 9614 9611 9709 9757 98032 99039 960323 960231 96038 960385 960339 960333 96041 9611 1069 11136 11184 1231 1279 13266 66131 1609 1136 1111 1058 1706 1733 1801 1409 1316 1563 1511 1658 1706 1733 1801 1746 1733		l	7176	7224	7272		7368	7416	7464	7512	7559	48 (
9 8564 8612 8659 8707 8755 8803 8850 8898 8046 910 959011 959019 959137 959185 959232 959203 959289 959375 959423 969019 95901 95901 95959 95928 959375 96047 9601 9709 9757 9604 96032 960321 960326 960326 960336 960336 960336 960335 960321 960326 960336 9603		ı						7894			8038	48 (
910 959041 9590e9 959137 959185 959239 959280 959378 959483 92 9990 95905 960042 960909 960138 960185 960233 960323 960323 960324 96090 960138 960185 960233 960323 960376 96338 960376 9633 960471 0518 0.566 0613 0.661 0.709 0.756 0.604 0.651 1.051 0.561 0.563 0.661 0.709 0.756 0.604 0.651 0.5 1421 1469 1.156 1.563 1.611 1.658 1.766 1.753 1.801 0.6 1.805 1.943 1.990 9.038 9.038 9.0376 96 0.6 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0		ı	8134	8181	8229			8373	8421	. 8468	8516	48 (
1 1 9518 9566 9614 9661 9709 9757 9604 9823 9900 2 9905 960042 960090 960138 960138 960233 960281 960389 960370 96370 96370 96383 960370 96038 960370 96038 960370 96038 960370 96038 960370 96038 960370 96038 960370 96038 960370 96038 960370 96038 960370 96038 960370 96038 960383 960393 960493 960491 9604118		ı	8612	8659	8707	8755	8803	8850	8898	8946	8994	48 (
1 9518 9566 9614 9661 9709 9757 9604 9829 9900 990042 960090 960138 960138 960233 960281 960382 960370 960371 95038 960376 960370 960371 96038 960376 960370 96038 960376 960370 96038 960376 960370 96038 960376 96038 960376 96038 960376 96038 960376 96038 960376 96038 960376 96038 960376 96038 960376 96038 96038 960376 96038 96038 960376 96038 96038 960376 96038 96038 96038 96038 96038 96038 96038 9608	0	اما	50000	050137	050185	050939	050990	050200	050375	050403	959471	48
5 5005 9600429 960090 960138 9601385 960233 960381 960386 960376 96 3 360471 0518 0566 613 0661 0709 0756 694 0851 4 0946 0994 1041 1099 1136 11194 1231 1279 1326 5 1421 1469 1516 1563 1511 1052 1706 1733 1801 6 1895 1943 1990 2038 2985 2132 2180 2227 2285 22227 2227 2275 8 2843 2890 2937 2985 3032 23079 3174 3214 3079 3174 32174 2464 2511 2559 2006 2633 2701 2748 8 2843 2890 2937 2985 3032 3079 3174 3217 4248 4949 4466 3673 3174 3217 4484	•	~									9947	48
5 960471 0518 0566 0613 0661 0709 0756 0804 0851 4 0946 0941 1041 1089 1136 1184 1231 1279 1336 5 1421 1469 1516 1563 1611 1658 1706 1753 1801 6 1895 1943 1990 2038 2485 2132 2180 2227 2275 8 2843 2890 2937 2965 3032 3079 3126 3174 3221 9 3316 3363 3410 3457 3504 3552 3599 96463 3693 920 963788 963835 963882 963999 963977 964024 964071 964165 96403 1 4290 4307 4354 4401 4448 4495 4542 4599 4637 2 4731 4778 4252 4572 4719 </th <td>0</td> <td>lor</td> <td></td> <td></td> <td>060138</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>960423</td> <td>48</td>	0	lor			060138						960423	48
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5 1491 1469 1516 1563 1611 1658 1706 1753 1901 6 1895 1943 1990 2038 2085 2132 2180 2927 2275 7 2369 2417 2464 2511 2539 2006 2633 2701 2748 8 2843 2890 2937 2085 3032 3079 3126 3174 3221 9 3316 3363 3410 3457 3504 3522 3599 3666 3693 920 963788 963885 963882 963929 963977 964024 964071 96418 96418 964165 967 1 4260 4307 4354 4401 4448 4495 4592 4593 4637 2 4731 4778 4825 4872 4872 4919 4966 5013 5061 5108 5788 5 6142		1									1374	48
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7 2369 24,17 2464 25,11 2559 2906 6553 2701 2748 8 2843 2890 2937 2965 3032 3079 3126 3174 3221 9.20 963788 963835 963882 963977 964024 964071 964118 964165 99 1 4360 4307 4354 4401 4448 4495 4542 4599 4637 2 4731 4778 4825 4872 4919 4966 5013 5061 5168 3 55292 5719 5766 5813 5590 5507 5944 5531 5578 4 5672 5719 5766 5813 5590 5376 5437 5444 5531 5578 4 5672 5719 5766 5623 5329 2637 5484 5531 5576 6 6142 6189 6236 6283 <td></td> <td>1</td> <td></td> <td></td> <td></td> <td>2085</td> <td>2132</td> <td></td> <td></td> <td></td> <td>2322</td> <td>47</td>		1				2085	2132				2322	47
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9 3316 3363 3410 3457 3504 3552 3599 3646 3693 920 963788 963835 963882 96392 963977 964024 964071 964118 964165 96 1 4260 4307 4354 4401 4448 4495 4542 4599 4637 2 4731 4778 4925 4872 4919 4966 5013 5061 5108 3 5202 5249 5296 5343 5390 5437 5484 5531 5578 4 5672 5719 5766 5813 5590 507 5954 6001 6048 5 6142 6189 6226 6283 6329 6376 6423 6470 6517 6 6111 6658 6705 6752 6799 6845 6892 6939 6996 7 7080 7127 7173 7220 7287 7314 7361 7408 7454 8 7548 7595 7642 7688 7735 7732 7829 6836 8969 9 8016 8062 8109 8156 8203 8249 8296 8348 8390 9 806483 966850 968576 96862 96869 96876 96876 96883 8969 9 9043 9090 9136 9183 9229 9276 9323 9 918 918 948 968 9043 9090 9136 9183 9229 9276 9323 9 918 918 948 948 959 9928 9975 97021 97068 97011 970807 97025 9 9 3 9868 9968 9968 9075 97029 97068 97011 970907 97027 7718 183 3 9882 9928 9928 9928 9927 9775 70029 10068 97011 970907 97025 9 9 70397 970393 970440 0486 0533 0579 0626 0672 0719 1 5 0812 0858 0946 0951 0997 10444 1090 1137 183 183 183 164 1601 1647 1647		1	2890	2937	2985		3079	3126	3174	3221	3268	47
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1 4390 4307 4354 4401 4448 4495 4549 4509 4637 2 4731 4778 4825 4872 4919 4966 5013 5061 5108 3 5202 5249 5296 5543 539 5437 5484 5531 5578 4 5672 5719 5766 5813 5860 5907 5954 6001 6048 55 66142 6189 6236 6283 6329 6376 6422 6770 6517 7080 7127 7173 7220 7267 7314 7361 7408 7458 6 6611 6688 6705 6752 6799 6845 6892 6939 6966 7 7080 7127 7173 7220 7267 7314 7361 7408 7458 9 8016 8062 8109 8156 8233 8249 8296 8343 8390 9806 8068 8068 809 8109 8156 8234 8296 8343 8390 80685 9 80685 9 80685 9 8068 9043 9090 9136 9183 9229 9276 9323 8296 9416 9463 9509 9556 9602 9649 9695 9742 9789 1 98016 9463 9509 9556 9602 9649 9695 9742 9789 1 98016 9468 9929 9975 97021 970068 97011 970161 970207 970254 9780 1 970347 970393 970440 0486 0533 0579 0626 0672 0719 1 97034 1321 1084 1089 1137 1183 1 1647 1089 1137 1183		١.,	****	062000	00000	002022	004004		004110		004010	
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3 59µ0 5949 5996 5343 5380 5437 5484 5531 5578 4 5672 5719 5766 5813 5860 5907 5954 6001 6048 5 6142 6189 6236 6283 6329 6376 6423 6649 6992 6999 6966 6517 66517 7980 7173 7220 7267 7314 7361 7408 7454 7454 7454 7454 7454 7454 7454 8296 8343 8390 9887 9826 8343 8390 7875 7922 8296 8343 8390 9868 9868 98670 98676 986810 986850 9868 98670 98671 986810 986856 986850 9868 9923 9229 9276 9323 2 9416 9463 9509 9556 9602 9649 9695 9742 9789 9436 9699 9979<		1									4684 5155	47
4 55729 5719 5766 5813 5860 5907 5954 6001 6048 5 6142 6189 6236 6283 6329 6376 6420 6470 6517 6 6611 6638 6705 6752 6799 6845 6892 6939 6986 7 7000 7127 7173 7220 7267 7314 7361 7408 7454 8 7548 7592 7642 7688 7735 7782 7899 7875 7992 930 968463 968530 96857 98867 98867 98876		1									5625	47
5 6142 6189 6236 62231 6329 6376 6423 6470 6517 6 6611 6688 6705 6752 6799 6845 6892 6939 6986 7 7080 7127 7173 7220 7267 7314 7361 7408 7454 8 7548 7595 7642 7688 7735 7782 7829 7875 7922 9 8016 8062 8109 8156 8203 8249 8296 98343 8390 1 8950 898576 968623 968670 968716 96853 968856 96859 9133 9229 9226 9726 9723 2 9416 9463 9509 9556 9902 9649 9695 9742 9769 3 9682 9928 9928 9928 9975 970011 97006 97114 97061 9707007 970254 <t< th=""><td></td><td>1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>6095</td><td>47</td></t<>		1									6095	47
6 6611 6659 6705 6752 6799 6845 6892 6939 6966 7 7060 7127 7173 7220 7267 7314 7361 7408 7458 8 7548 7595 7642 7688 7735 7782 7829 7875 7922 8016 8062 8109 8156 6203 8249 8296 8343 8390 9806 8062 8109 8156 6203 8249 8296 8343 8390 930 968483 968530 96856 968623 968670 968716 969763 968810 968856 9 18950 8996 9043 9090 9136 9183 9229 9276 9323 829 9416 9463 9509 9556 9062 9649 9695 9742 9789 3 9829 9928 9928 9928 9975 97021 97068 87011 970161 970207 970234 97024 970347 970347 970393 970440 0486 0533 0579 06926 0672 0719 5 0812 0858 0994 0951 9977 1044 1090 1137 1183 6 1276 1332 1369 1415 1461 1508 1554 1601 1647		Ì									6564	47
7 7060 7127 7173 7220 7287 7314 7361 7408 7454 8 7548 7595 7642 7688 7735 7782 7829 7875 7922 9 8016 8062 8109 8156 8203 8249 8296 833 8390 1 8950 8966 9043 9900 9136 9183 9229 9276 9323 2 9416 9463 9509 9556 9602 9649 9695 9742 9769 9729 3 9882 9928 9975 97021 97006 970114 970161 970224 9769 9723 4 970347 9703393 970440 0486 0533 0579 0626 0672 0719 5 0812 0858 0904 0951 0997 1044 1090 1137 1183 5 0812 1382 1369		ì									7033	47
8 7548 7555 7642 7688 7733 7782 7829 7875 7922 930 96868 809 8156 8203 8249 8296 8343 8390 1 8950 8968 9443 9690 9136 9183 9229 9276 9323 2 9416 9463 9509 9556 9602 9649 9695 9742 9789 3 9829 9928 9975 97021 97068 97011 970207 970254 970254 970207 970254 970207 970254 9719 4 970347 970393 970440 0486 0533 0579 0626 0672 0719 5 0812 0888 094 0951 0971 1044 1090 1137 1183 6 1276 1332 1369 1415 1461 1508 1534 1601 1647		l									7501	47
9 8016 8062 8109 8156 8303 8249 8296 8343 8390 930 968463 968530 968576 968623 968670 968716 968763 968810 968567 9130 9136 9136 9133 9229 9276 9323 929 9416 9463 9509 9556 9602 9649 9695 9742 9789 3 9882 9928 9928 9975 970021 970068 970114 970161 970207 970254 9780 9780 9780 9780 9780 9780 9780 9780		l									7969	47
930 968483 968530 968576 968623 968670 968716 968763 968810 968856 9 1 8950 8996 9043 9090 9136 9183 9229 9276 9323 2 9416 9463 9509 9536 9602 9649 9695 9742 9789 3 9882 9928 9928 9975 97021 970068 97011 970061 97011 970254 979224 9719 4 970347 970393 970440 0486 0533 0579 0696 0672 0719 5 0812 0858 094 0951 0997 1044 1090 1137 1183 6 1276 1332 1369 1415 1461 1508 1554 1601 1647		1									8436	47
1 8950 8996 9043 9990 9136 9183 9229 9276 9323 3 9862 9943 9509 9556 9602 9649 9652 9742 9789 3 9882 9928 9975 970021 970068 970114 970161 970224 970234 4 970347 9703393 970440 0486 0533 0579 0628 0672 0719 5 0812 0858 0904 0951 0997 1044 1090 1137 1183 6 1276 1332 1369 1415 1461 1508 1554 1601 1647	_	l		-				1				i -)
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9 2666 2712 2758 2804 2851 2897 2943 2989 3035	_	<u>_</u>	3/12	2/38	2701	2001	2897	2943	2969	3030	3082	40
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940	973128	973174	973220	973266	973313	973359	973405	973451	973497	973543	46
1	3590	3636	3682	3728	3774	3820	3866	3913	3959	4005	46
2	4051	4097	4143	4189	4235	4281	4327	4374	4420	4466	46
3	4512	4558	4604	4650	4696	4742	4788	4834	4880	4926	46
4	4972	5018	5064	5110	5156	5202	5248	5294	5340	5396	46
5	5432	5478	5524	5570	5616	5662	5707	5753	5799	5845	46
6	5891	5937	5983	6029	6075	6121	6167	6212	6258	6304	46
7	6350	6396	6442	6488	6533	6579	6625	6671	6717	6763	46
8	6808	6854	6900	6946	6992	7037	7083	7129	7175	7220	46
9	7266	7312	7358	7403	7449	7495	7541	7586	7632	7678	46
950	977724	977769	977815	977861	977906	977952	977998	978043	978089	978135	46
il	8181	8226	8272	8317	8363	8409	8454	8500	8546	8591	46
2	8637	8683	8728	8774	8819	8865	8911	8956	9002	9047	46
3	9093	9138	9184	9230	9275	9321	9366	9412	9457	9503	46
4	9548	9594	9639	9685	9730	9776	9821	9867	9912	9958	46
5	980003	980049	980094	980140	980185	980231	980276	980322	980367	980412	45
6	0458	0503	0549	0594	0640	0685	0730	0776	0821	0967	45
7	0912	0957	1003	1048	1093	1139	1184	1229	1275	1320	45 /
8	1366	1411	.1456	1501	1547	1592	1637	1683	1728	1773	45
9	1819	1864	1909	1954	2000	2045	2090	2135	2181	2226	45
960	089971	982316	089380	099407	090450	982497	000542	000500	000672	982678	45
200	2723	2769	2814	2859	2904	2949	2994	3040	3085	3130	45
2	3175	3220	3265	3310	3356	3401	3446	3491	3536	3581	45
3	3626	3671	3716	3762	3807	3852	3897	3942	3987	4032	45
4	4077	4122	4167	4212	4257	4302	4347	4392	4437	4482	45 (
5	4527	4572	4617	4662	4707	4752	4797	4842	4887	4932	45 (
6	4977	5022	5067	5112	5157	5202	5247	5292	5337	5382	45 (
7	5426	5471	5516	5561	5606	5 651	5696	5741	5786	5830	45 (
8	5875	5920	5965	6010	6055	6100	6144	6189	6234	6279	45 (
9	6324	6369	6413	6458	6503	6548	6593	6637	6682	6727	45 (
970	986772	986817	986861	986906	neens 1	000000	987040	002005	987130	987175	45
3.0	7219	7264	7309	7353	7398	7443	7488	7532	7577	7622	45
2	7666	7711	7756	7800	7845	7890	7934	7979	8024	8068	
3	8113	8157	8202	8247	8291	8336	8381	8425	8470	8514	45
4	8559	8604	8648	8603	8737	8782	8826	8871	8916	8960	45
5	9005	9049	9094	9138	9183	9227	9272	9316	9361	9405	45
6	9450	9494	9539	9583	9628	2672	9717	9761	9806	9850	44 5
7	9895	9939		990028	990072	990117			990250	990294	44 5
8	990339		990428	0472	0516	0561	0605	0650	0694	0738	44)
9	0783	0827	0871	0916	0960	1004	1049	1093	1137	1182	44)
980	001996	991270	001315	001350	001402	991448	001400	001526	001500	001605	44
300	1669	1713	1758	1802	1846	1890	1935	1979	2023	2067	44 (
2	2111	2156	2200	2244	2288	2333	1935 2377	2421	2465	2509	44 (
· 3	2554	2598	2642	2686	2730	2774	2819	2863	2907	2951	44 (
4	2995	3039	3083	3127	3172		3260	3304	3348	3392	44 (
5	3436	3480	3524	3568		3657	3701	3745	3789	3833	44 (
6	3877	3921	3965	4009	4053	4097	4141	4185	4229	4273	44 (
7	4317	4361	4405	4449	4493		4581	4625	4669	4713	44 3
8		4801	4845	4889	4933	4977	5021	5065	5108	5152	44 (
9	5196	5240	5284	5328	5372	5416	5460	5504	5547	5591	44 (
990				995767)
1	6074			6205		6293			995986 6424		44 \
2	6512	6117 6555	6161 6599	6643	6249 6687	6731	6337 6774	6380 6818	6862	6468 6906	44 >
3	6949	6993	7037	7080	7124	7168	7212	7255	7299	7343	44
4	7386	7430	7474	7517	7561	7605	7648	7692	7736	7779	44 5
5	7823	7867	7910	7954	7998		8085	8129	8172	8216	44 (
6	8259	8303	8347	8390	8434	8477	8521	8564	8608	8652	44 5
7	8695	8739	8782	8826	8869	8913	8956	9000	9043	9087	44 4
8	9131	9174	9218	9261	9305	9348	9392	9435	9479	9522	44 5
9	9565	9609	9652	9696	9739		9826	9870	9913		43 5
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LOGARITHMIC

SINES AND TANGENTS,

FOR EVERY

DEGREE AND MINUTE

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THE QUADRANT.

N. B. The minutes in the left-hand column of each page, increasing downwards, belong to the degrees at the top; and those increasing upwards, in the right-hand column, belong to the degrees below.

M.		~~~~	Coeine	ĭ Ď.		D.		Ľ
0	0.000000		10-000000	Ī	0.000000		Infinite.	60
1	6.463726	501717	000000	00	6.463726	501717	13.536274	59 58
2	764756	293485	000000	00	764756	293483	235244 059153	56 57
3	940847	208231	000000	00	940847 7-065786	208231 161517	12:934214	56
4 5	7.065786	161517	000000	00	162696	131969	837304	55
6	162696	131968	9-999999	oi	241878	111578	758122	54
7	241877 308824	111575 96653	999999	oi	308825	99653	691175	53
8		85254	999999	oi	366817	85254	633183	52
9	366816 417968	76263	999999	oi	417970	76263	582030	51
10	463725	68988	999999	oi	463727	68988	536273	50
						1		
11	7.505118	62981	9-999998	01	7.505120	6298;	12-494880	49
12	542906	57936	999997	01	542909	57933	457091	48
13	577668	53641	999997	01	577672	53642	422328	47
14	609853	49938	999996	01	609857	49939	390143	46 45
15	639816	46714	999996	01	639820	46715	360180 332151	44
16	667845	43881	999995	01	667849	43882		43
17	694173	41372	999995	01	694179	41373	305821	42
18	718997	39135	999994	01	719003	39136	280997	41
19	742477	37127	999993	01	742484	37128	257516 235239	40
200	764754	35315	999993	01	764761	35136		
21	7.785943	33672	9-999992	01	7.785951	33673	12-214049	39
22	806146	32175	999991	01	806155	32176	193845	38
23	825451	30805	999990	01	825460	30806	174540	37
24	843934	29547	999989	02	843944	29549	156056	36
25	861662	28388	999988	02	861674	28390	138326	35
26	878695	27317	999988	02	878708	27318	121292	34
27	895085	26323	999987	02	895099	26325	104901	33
28	910879	25399	999986	02	910894	25401	089106	32
29	926119	24538	999985	02	926134	24540	073866	31
30	940842	23733	999983	02	940858	23735	059142	30
31	7.955082	22980	9.999982	02	7.955100	22981	12-044900	29
32	968870	22273	999981	02	968889	22275	031111	28
33	982233	21608	999980	02	982253	21610	017747	27
34	995198	20981	999979	02	995219	20983	004781	26
35	8.007787	20390	999977	02	8.007809	20392	11.992191	25
36	020021	19831	999976	02	020045	19833	979955	24
37	031919	19302	999975	02	031945	19305	968055	23
38	043501	18801	999973	02	043527	18803	956473	22
39	054781	18325	999972	02	054809	18327	945191	21
40	065776	17872	999971	02	065806	17874	934194	20
41	8.076500	17441	9-999969	02	8.076531	17444	11.923469	19
42	086965		999968	02	086997	17034	913003	18
43	090903	17031 16639	999966	02	097217	16642	902783	17
44	107167	16265	999964	03	107202	16268	892797	16
45	116926	15908	999963	03	116963	15910	883037	15
46	126471	15566	999961	03	126510	15568	873490	14
47	135810	15238	999959	03	135851	15241	864149	13
48	144953	14924	999958	63	144996	14927	855004	12
49	153907	14622	999956	03	153952	14627	846048	iĩ
50	162681	14333	999954	03	162727	14336	837273	10
				1		•		ı
51	8.171280	14054	9-999952	03	8.171328	14057	11.828672	9
52	179713	13786	999950	03	179763	13790	820237	87
53	187985	13529	999948	03	188036	13532	811964	
54	196102	13280	999946	03	196156	13284	803844	6
55	204070	13041	999944	03	204126	13044	795874	5
56	211895	12810	999942	04	211953	12814	788047	4
57	219581	12587	999940	04	219641	12590	780359	3
58	227134	12372	999938	04	227195	12376	772805	2
59	234557	12164	999936	04	234621	12168	765379	1
60	241855	11963	999934	04	241921	111967	758079	0

89 Degrees

(N.	8ine	~~~~	Cosine		Tang,		Cotang.	~~
0	8-241855	11963	9-999934	04	8-241921	11967	11.758079	60 (
1	₄ 249033	11768	999932	04	249102	11772	750898	59 (
3	256094	11580	999929	04	256165	11584	743835	58 (
3	263042	11398	999927	04	263115	11402	736885	57 (
5	269881 276614	11221 11050	999925 999922	04	269956 276691	11225 11054	730044 723309	56 S
۱۲ و	283243	10883	999920	04	283323	10887	716677	54 2
۲ ۲	289773	10721	999918	04	289856	10726	710144	53 }
⟨š	296207	10565	999915	04	296292	10570	703708	52 ₹
9	302546	10413	999913	04	302634	10418	697366	51 (
(10	308794	10266	999910	04	308884	10270	691116	50 〈
11	8.314954	10122	9-999907	04	8.315046	10126	11.684954	49 5
12	321027	9982	999905	04	321122	9987	678878	48 5
13	327016	9847	999902	04	327114	9851	672886	47 5
14	332924	9714	999899	05	333025	9719	666975	46)
15	338753 344504	9586 9460	999897 999894	05 05	338856	9590 9465	661144	45 \
} 18	350181	9338	999891	05	344610 350289	9343	655390 649711	43
18	355783	9219	999888	05	355895	9224	644105	42 (
(19	361315	9103	999885	95	361430	9108	638570	41 (
20	366777	8990	999882	05	366895	8995	633105	40 5
21	8.372171	8880	9-999879	05	8.372292	8885	11.627708	39 5
22	377499	8772	999876	05	377622	8777	622378	38
23	382762	8667	999873	05	382889	8672	617111	37 }
24	387962	8564	999870	05	388092	8570	611908	36 (
25	393101	8464	999867	05	393234	8470	606766	35 ∤
26	368179	8366	999864	05	398315	8371	601685	34. ∤
27 28	403199 408161	8271 8177	999861 999858	05 05	403338 408304	8276 8182	596662 591696	33 }
29	413068	8086	999854	05	413213	8091	586787	31 /
30	417919	7996	999851	06	418068	8002	581932	36 >
31	8.422717	7909	9-999848	06	8-422869	7914	11.577131	29
32	427462	7823	999844	06	427618	7830	572382	28 (
33	432156	7740	999841	06	432315	7745	567685	27 ₹
34	436800	7657	999838	06	436962	7663	563038	26 ⟨
35	441394	7577	999834	06	441560	7583	558440	25 (
36	445941	7499	999831	06	446110	7505	553890	24 (
₹ 37	450440	7422	999827	06	450613	7428	549387	23 (
38	454893	7346	999823	06	455070	7352	544930	22 (
39 40	459301 463665	7273 7200	999820 999816	06 06	459481 463849	7279 7206	540519 536151	21 (
	1					1	1	
41	8·467985 472263	7129 7060	9·999812 999809	06 06	8·468172 472454	7135 7066	11·531828 527546	19 }
43	476498	6991	999805	06	476693	6998	523307	176
44	480693	6924	999801	06	480892	6931	519108	16
45	484848	6859	999797	07	485050	6865	514950	15 5
46	488963	6794	999793	07	489170	6801	510830	14 5
47	493040	6731	999790	07	493250	6738	506750	13 5
₹48	497078	6669	999786	07	497293	6676	502707	12)
49	501080	6608	999782	07	501298	6615	498702	111 >
₹ 50	505045	6548	999778	07	505267	6555	494733	10 }
51	8.508974	6489	9-999774	07	8.509200	6496	11.490800	9)
52	512867	6431	999769	07	513098	6439	486902	8 (
(53 54	516726	6375	999765	07	516961	6382 6326	483039 479210	6
55	520551 524343	6319 6264	999761 999757	07	520790 524586	6272	475414	35
56	524343 528102	6211	989753	07	528349	6218	471651	4)
57	531828	6158	999748	07	532080	6165	467920	3 9
₹ 58	535523	6106	999744	07	535779	6113	464221	2)
(59	539186	6055	999740	07	539447	6062	460553	1)
60	542819	6004	999735	07	543084	6012	456916	1 0)
(l Cosine		Sine	1	1 Cotang.	1	I Tang.	I ML

88 Degrees.

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<u> </u>				·			Cotang.	{
5 0	8-542819	6004	9-999735	07	8-543084	6019	11.456916	1 60 (
5 1	546422	5955	999731	U7	546691	5962	453309	59 (
( 2	549995	5906	999726	07	550968	5914	449732	58 (
3	553539	5858	999722	08	553817	5866	446183	1 57 C
5 4	557054	5811	999717	08	557336	5819	442664	56 (
5 5	560540	5765	999713	08	560828	5773	439172	55 c
5 6	563999	5719	999708	08	564291	5727	435709	54 (
۲ أ	567431	5674	999704	08	567727	5682	432273	53 (
( è	570836	5630	999699	08	571137	5638	428863	59
( ğ	574214	5587	999694	08	574520	5595	425480	51
\ 10	577566	5544	999689	08	577877	5559	422123	50
/ -	8-580892	5509	9-999685	08	8-581208	5510	11.418792	49 (
711						5468		
2 12	584193	5460	999680	08 08	584514	5427	415486 412205	48 5
2 13	587469	5419	999675		587795			47 5
2 14	590721	5379	999670	08	591051	5387	408949	46 5
2 15	593948	5339	999665	08	594283	5347	405717	45 5
16	597152	5300	999660	08	597492	5308	402508	44 5
) 17	600332	5261	999655	08	600677	5270	399323	43 5
) 18	603489	5223	999650	08	603839	5232	396161	42 (
) 19	606623	5186	999645	09	606978	5194	393022	41 1
<b>∑20</b>	609734	5149	999640	09	610094	5158	389906	40)
21	8-612823	5112	9-999635	09	8-613189	5121	11:386811	39 5
22	615891	5076	999629	09	616262	5085	383738	38
23	618937	5041	999624	09	619313	5050	380687	37 5
5 24	621962	5006	999619	09	622343	5015	377657	36
25	624965	4972	999614	09	625352	4981	374648	35 5
5 2 6 E	627948	4938	999608	09	628340	4947	371660	34 5
5 27	630911	4904	999603	09	631308	4913	368692	33 5
§ 28	633854	4871	999597	09	634256	4880	365744	32
5 220	636776	4839	999592	09	637184	4848	362816	31 5
30	639680	4806	999586	09	640093	4816	359907	30 5
(								1 (
31	8.642563	4/75	9-999581	09	8-642982	4784	11.357018	29 (
⟨322	645428	4743	999575	09	645853	4753	354147	28 (
₹ 33	648274	4712	999570	09	648704	4722	351296	27 (
⟨ 34	651102	4682	999564	09	651537	4691	348463	26 (
₹ 35	653911	4652	999558	10	654352	4661	<b>34</b> 5648	25 (
<b>∂36</b>	656702	4622	999553	10	657149	4631	342851	24 (
<b>∂37</b>	659475	4592	999547	10	659928	4602	340072	23 (
<b>∂38</b>	662230	4563	999541	10	662689	4573	337311	292 ⟨
<b>∂39</b>	664968	4535	999535	10	665433	4544	334567	21 (
<b>∤40</b>	667689	4506	999529	10	668160	4526	331840	20 (
₹41	8-670393	4479	9-999524	10	8-670870	4488	11.329130	19 (
₹ 42	673080	4451	999518	10	673563	4461	326437	l is (
2 43	675751	4424	999512	10	676239	4434	323761	1 17 3
₹ 44	678405	4397	999506	10	678900	4417	321100	î6 ⟨
₹ 45	681043	4370	999500	10	681544	4380	318456	15 3
₹ 46	683665	4344	999493	10	684172	4354	315828	14 3
247	686272	4318	999487	10	686784	4328	313216	13 ₹
48	688863	4292	999481	10	689381	4303	310619	112 }
49	691438	4267	999475	10	691963	4277	308037	111
50	693998	4242	999469	10	694529	4252	305471	10 3
:				l .		1		
51	8.696543	4217	9-999463	11	8.697081	4228	11.302919	9 }
52	699073	4192	999456	11	699617	4203	300383	8
53	701589	4168	999450	11	702139	4179	297861	7
54	704090	4144	999443	11	704646	4155	295354	6 ;
55	706577	4121	999437	11	707140	4132	292860	5 >
56	709049	4097	999431	11	709618	4108	290382	4 5
57	711507	4074	999424	11	712083	4085	287917	3 3
₹ 58	713952	4051	999418	11	714534	4062	285465	2 >
59	716383	4029	999411	11	716972	4040	283028	1)
<b>60</b>	718800	4006	999404	11	719396	4017	280604	l o S
ζ	Corre				1 Cot		I T	M. }
1	Cosine		L~ Sine~	حمد!	Cotang.	سممل	Tang.	لتتد

87 Degrees.

SM.	Sine		Coeine	~~~	Tang.	~~~~	Cotang.	~~
50	8.718800	4006	9-999404	11	8.719396	4017	111-280604	60 (
<b>1</b>	721204	3984	999398	11	721806	3995	278194	59 (
₹ 2	723595	3962	999391	111	724204	3974	275796	58 (
3 4	725972 728337	3941 3919	999384 999378	111	726588 728959	3952 3930	273412 271041	56
5	730688	3898	999371	lii	731317	3909	268683	55 5
) 6	733027	3877	999364	12	733663	3889	266337	54 )
7	735354	3857	999357	12	735996	3868	264004	53 )
8 (	737667	3836	999350	12	738317	3848	261683	52)
9.5	739969 742259	3816 3796	999343 999336	12 12	740626 742922	3827 3807	259374 257078	51 >
} 10				1				50 }
\ \frac{11}{12}	8·744536 746802	3776 3756	9-999329 999322	12 12	8·745207 747479	3787 3768	11.254793 252521	49 } 48 }
13	749055	3737	999315	12	749740	3749	250260	47 (
14	751297	3717	999308	12	751989	3729	248011	46 )
2 15	753528	3698	999301	12	754227	3710	245773	45 }
<b>2 16</b>	755747	3679	999294	12	756453	3692	243547	44 )
₹ 17	757955	3661	999286	12	758668	3673	241333	43 )
\ 18 19	760151 762337	3642 3624	999279 999272	12	760872 763065	3655 3636	239128 236935	42 \
20	764511	3606	999265	12	765246	3618	234754	40 ⟨
21	8.766675	3588	9-999257	12	8.767417	3600	11.232583	39
222	768828	3570	999250	13	769578	3583	230422	38 (
<b>∂</b> 23	770970	3553	999242	13	771727	3565	228273	37
₹ 24	773101	3535	999235	13	773866	3548	226134	36 )
₹ 25	775223	3518	999227	13	775995	3531	224005	35 >
26 27	777333	3501 3484	999220	13	778114	3514	221886	34 \
28	779434 781524	3467	999212 999205	13 13	780222 782320	3497 3480	219778 217680	33 }
29	783605	3451	999197	13	784408	3464	215592	31 (
> 30	785675	3431	999189	13	786486	3447	213514	36 (
₹ 31	8.787736	3418	9-999181	13	8.788554	3431	11.211446	29 5
(32	789787	3402	999174	13	790613	3414	209387	28 )
(33	791828	3386	999166	13	792662	3399	207338	27 )
34	793859	3370	999158	13	794701	3383	205299	26 }
35	795881 797894	3354 3339	999150 999142	13 13	796731	3368 3352	203269	25 }
37	799897	3323	999134	13	798752 800763	3337	201248 199237	23 5
. 38	801892	3308	999126	13	802765	3322	197235	222 5
( 39	803876	3293	999198	13	804758	3307	195242	21 }
<b>( 40</b>	805852	3278	999110	13	806742	3292	193258	20
\$ 41	8.807819	3263	9.999102	13	8.808717	3278	11-191283	19 }
5 42	809777	3249	999094	14	810683	3262	189317	18 (
43	811726	3234	999086	14	812641	3248 3233	187359	17 }
44	813667 815599	3219 3205	999077 999069	14 14	814589 816529	3233 3219	185411 183471	16 } 15 }
46	817522	3191	999061	14	818461	3205	181539	14
47	819436	3177	999053	14	820384	3191	179616	13 }
<b>5 48</b>	821343	3163	999044	14	822298	3177	177702	12 >
49	823240	3149	999036	14	824205	3163	175795	11 }
50	825130	3135	999027	14	826103	3150	173897	10 }
251	8.827011	3122	9-999019	14	8-827992	3136	11.172008	9 (
52	828884 830749	3108 3095	999010 999002	14 14	829874 831748	3123 3110	170126 168252	8 }
54	832607	3093	999002	14	833613	3096	166387	6 5
55	834456	3069	998984	14	835471	3083	164529	5 }
56	836297	3056	998976	14	837321	3070	162679	4 /
57	838130	3043	998967	15	839163	3057	160837	3 )
58	839956	3030	998958	15	840998	3045	159002	2 }
59	841774	3017	998950	15 15	842825	3032	157175	1 }
<u>60</u>	843585	3000	998941		844644	3019	155356	0 }
(	Cosine	<u> </u>	Sine	1	Cotang.		Tang.	M. {

86 Degrees.

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<u>₩</u>		) D.	•			·		~~~
٥ (	8.843585	3005	9-998941	15	8.844644	3019	11.155356	60 (
7 1	845387	2992	998932	15	846455	3007	153545	59 (
2	847183	2980	998923	15	848260	2995	151740	58 ¢
} 3	848971	2967	998914	15	850057	2982	149943	57 (
2 4	850751	2955	998905	15	851846	2970	148154	56 (
5 5	852525 854291	2943	998896	15	853628	2958	146372	55 (
6 7	856049	2931 2919	998887 998878	15	855403 857171	2946 2935	144597	54 (
\ 8	857801	2907	998869	15 15	858932	2923	142829 141068	53 (
٥ ١	859546	2896	998860	15	860686	2923	139314	51 2
10	861283	2884	998851	15	862433	2900	137567	50 2
511	8.863014	2873	9-998841			2888		
12	864738	2861	998832	15 15	8-8641 <b>73</b> 865906	2877	11·135827 134094	49 {
13	866455	2850	998823	16	867632	2866	132368	47 2
14	868165	2839	998813	16	869351	2854	130649	46 (
) 15	869868	2828	998804	16	871064	2843	128936	45 (
) 16	871565	2817	998795	16	872770	2832	127230	44 (
) 17	873255	2806	998785	16	874469	2821	125531	43 ⟨
18	874038	2795	998776	16	876162	2811	123838	42 (
19	876615	2786	998766	16	877849	2800	122151	4ã (
<b>≥20</b>	878285	2773	998757	16	879529	2789	120471	40 (
21	8-879949	2763	9-998747	16	8.881202	2779	11.118798	39 {
( 22	881607	2752	998738	16	882869	2768	117131	38 ⟨
( 23	883258	2742	998728	iš	884530	2758	115470	ا 37 <b>د</b>
(24	884903	2731	998718	16	886185	2747	113815	36 5
( 25	886542	2721	998708	16	887833	2737	112167	35 (
( 26	888174	2711	998699	16	889476	2727	110524	34 5
(27	889801	2700	998689	16	891112	2717	108888	33 \
⟨28	891421	2690	998679	. 16	892742	2707	107258	322 \
⟨ 29	893035	2680	998669	17	894366	2697	105634	31 5
ζ30	894643	2670	998659	17	895984	2687	104016	30 5
5 31	8.896246	2660	9-998649	17	8.897596	2677	11-102404	29 5
532	897842	2651	998639	17	899203	2667	100797	28 )
5 33	899432	2641	998629	17	900803	2658	099197	27)
5 34	901917	2631	998619	17	902398	2648	097602	26)
35	902596	2622	998609	17	903987	2638	096013	25 )
36	904169	2612	998599	17	905570	2629	094430	24 \
37	905736	2603	998589	17	907147	2620	092853	23 >
38	907297	2593	998578	17	908719	2610	091281	22 >
39	908853	2584 2575	998568	17	910285	2601	089715	21 20 2
/	910404		998558	17	911846	2592	088154	
<b>\ 41</b>	8.911949	2566	9-998548	17	8.913401	2583	11.086599	19 )
242	913488	2556	998537	17	914951	2574	085049	18 )
243	915022	2547	998527	17	916495	2565	083505	17 2
244	916550	2538	998516	18	918034	2556	081966	16 2
\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	91807 <b>3</b> 919591	2529 2520	998506	18 18	919568	2547 2538	080432 078904	15 }
3 47 47	919591	2512 2512	99849 <b>5</b> 99848 <b>5</b>	18	921096 922619	2538 2530	077381	14 }
48	922610	2503	998474	18	924136	2521	075864	12/
49	924112	2494	998464	18	925649	2512	074351	1115
50	925609	2486	998453	18	927156	2503	072844	165
/ 51	8-927100			18	1		11.071342	١,
/ 51 / 52	928587	2477 2469	9-998442	18	8·928658 930155	2495 2486	069845	8
/ 53	930068	2460	998431 998421	18	930133	2400 2478	068353	35
54	931544	2400 2452	998410	18	933134	2470	066866	65
55	933015	2443	998399	18	934616	2461	065384	5
7 56	934481	2435	998388	18	936093	2453	063907	45
57	935942	2427	998377	18	937565	2445	062435	3 5
58	937398	2419	998366	iš	939032	2437	060968	25
59	938850	2411	998355	18	940494	2430	059506	( i)
60	940296	2403	998344	18	941952	2421	058048	١ō۶
<b>}</b>	Cosine		Sine	ı	I Cotene	1	Tang.	ML (
1	, coming		- Cine	١	Cotang.	۔ ۔ ۔ ۔'	T THEFT	دحہ

ſ¥.	Sine .	~~~~	Cosine		Tang.	~~~~	Cotang.	<b>,~</b> ~,
\ <del></del>	8-940296	2403	9-998344	1 D.	Tang.   8.941952	2421	Cotang.	1 60
Į i	941738	2394	998333	19	943404	2413	056596	59
, 5	943174	2387	998322	19	944852	2405	055148	58
$\tilde{3}$	944606	2379	998311	19	946295	2397	053705	57)
? 4	946034	2371	996300	19	947734	2390	052266	56 5
( 5	947456	2363	998289	19	949168	3292	050832	55 )
( 6	948874	2355	998277	19	950597	2374	049403	54 >
( 7	950287	2348	998266	19	952021	2366	047979	53 >
\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	951696 953100	2340 2332	998255 998243	19 19	953441 954856	2360 2351	046559 045144	52 >
<b>₹ 10</b>	954499	2325	998232	19	956267	2344	043733	56 (
111	8-955894	2317	9-998220	19	8-957674	2337	11.042326	49
₹ 12	957284	2310	998209	19	959075	2329	040925	48
⟨ iã	958670	2302	998197	19	960473	2323	039527	47 )
( 14	960052	2295	998186	19	961866	2314	038134	46 >
( 15	961429	2288	998174	19	963255	2307	036745	45 2
5 16	962801	2280	998163	19	964639	2300	035361	44 (
5 17	964170 965534	2273 2266	998151 998139	19 20	966019	2293 2286	033981 032606	43 }
{ 18 19	966893	2259	998128	20	967394 968766	2279	031234	41 5
20	968249	2252	998116	20	970133	2271	029867	40 5
21	8.969600	2244	9-998104	20	8.971496	2265	11.028504	39 (
\ 22	970947	2238	998092	20	972855	2257	027145	38
〈 23	972289	2231	998080	20	974209	2251	025791	37
( 24	973628	2224	998068	20	975560	2244	024440	36 ?
25	974962	2217	998056	20	976906	2237	023094	35 (
5 26	976293	2210	998044	20	978248	2230	021752	34 (
5 27	977619	2203	998032	20	979586	2223	020414	33 ⟨
<b>5 28</b>	978941 980259	2197	998020 998008	20 20	980921 982251	2217 2210	019079	32 \ 31
\ 29 30	981573	2190 2183	997996	20	983577	2210	017749 016423	30
,		ĺ						I S
31	8-982883 984189	2177 2170	9-997984 997972	20 20	8·984899 986217	2197 2191	11·015101 013783	29 (
33	985491	2163	997959	20	987532	2184	012468	27 (
34	986789	2157	997947	20	988842	2178	011158	26 (
35	988083	2150	997935	21	990149	2171	009851	25 (
36	989374	2144	997922	21	991451	2165	008549	24 (
37	990660	2138	997910	21	992750	2158	007250	23 (
) 38	991943	2131	997897	21	994045	2152	005955	22 5
39 40	993222 994497	2125 2119	997885 997872	21 21	995337 996624	2146 2140	004663 003376	21 6
) 41	8-995768	2112	9-997860	21	8-997908	2134 2127	11.002092	19 }
) 42	997036 998299	2106 2100	997847 997835	21 21	999188 000465	2127	009812 10-999535	173
344	999560	2094	997822	21	001738	2115	998262	16 5
3 45	9.000816	2087	997809	21	003007	2109	996993	15 5
) 46	002069	2082	997797	21	004272	2103	995728	145
) 47	003318	2076	997784	21	005534	2097	994466	13 >
) 48	004563	2070	997771	21	006792	2091	993208	12 >
\ 49 50	005805	2064 2058	997758	21 21	008047 009298	2085 2080	991953 990702	11 }
,	007044		997745				1	(
2 51	8.008278	2052	8-997732	21	8.010546	2074	10-989454	9 }
2 52 53	009510 010737	2046 2040	997719 997706	21 21	011790 013031	2068 2062	989210 986969	8 }
54	011962	2040	997693	22	013031	2056	985732	65
55	013182	2029	997680	22	015502	2051	984498	5 5
> 56	014400	2023	997667	22	016732	2045	983268	4)
57	015613	2017	997654	22	017959	2040	982041	3 }
) 58	016824	2012	997641	22	019183	2033	980817	2 }
) 59	018031	2006	997628	22	020403	2028	979597	1 1 2
<u>} 60</u>	019235	2000	997614	22	021620	2023	¹ 973380	10}
ζ.	Cosine	1	Sine	1	Cotang.	1	Tang.	I ML (

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5 M.	Sine	~~~~	Cosine	~~~~	Tang.		Cotang.	~~7
> 0	9-019235	2000	9-997614	1 22	9-021620	2023	10-978380	1 60
λĭ	020435	1995	997601	92	022834	2017	977166	59
λě	021632	1989	997588	22	024044	2011	975956	58
) ã	022825	1984	997574	99	025251	2006	974749	57
) <u>ă</u>	024016	1978	997561	92	026455	2000	973545	56
} 5	025203	1973	997547	22	027655	1995	979345	1 55 9
) š	026386	1967	997534	23	028852	1990	971148	54
¿ 7	027567	1962	997520	23	030046	1985	969954	53
ζġ	028744	1937	997507	23	031237	1979	968763	52
٧ŏ	029918	1951	997493	23	032425	1974	967575	51
λio i	031089	1947	997480	23	033609	1969	966391	50
,	9-032257		9-997466	23	9-034791	1964	10-965209	49
3 11	033421	1941 1936	997452	23	035969	1958	964031	48
( 12				23		1953	962856	47
( 13	034582	1930	997439	23	037144			
( 14	035741	1925	997425		038316	1948	961684	46
( 15	036896	1920	997411	23	039485	1943	960515	45
\$ 16	038048	1915	997397	23	040651	1938	959349	44
(17	039197	1910	997383	23	041813	1933	958187	43
(18	040342	1905	997369	23	042973	1928	957027	42
ζ 19	041485	1899	997355	23	044130	1923	955870	41
<b>∫20</b>	042625	1894	997341	23	045284	1918	954716	40
\$ 21	9 043762	1889	9-997327	24	9.046434	1913	10-953566	39
\$ 22	044895	1884	997313	24	047582	1908	952418	38 (
23	046026	1879	997299	24	048727	1903	951273	37
(24	047154	1875	997285	24	049869	1898	950131	36
25	048279	1970	997271	24	051008	1893	948992	35
26	049400	1865	997257	24	052144	1889	947856	34
\$ 27	050519	1860	997242	24	053277	1884	946723	33
§ 28	051635	1855	997228	24	054407	1879	945593	32
5 29	052749	1850	997214	24	055535	1874	944465	31
5 30	053859	1845	997199	24	056659	1870	943341	30
	1		1		•		10-942219	29
31	054966	1841	9-997185	24	9-057781	1865		
₹ 32	056071	1836	997170	24	058900	1869	941100	28
₹ 33	057172	1831	997156	24	060016	1855	939984	27
₹ 34	058271	1827	997141	24	061130	1851	938870	26
₹ 35	059367	1822	997127	24	062240	1846	937760	25
₹ 36	060460	1817	997112	24	063348	1842	936652	24
( 37	061551	1813	997098	24	064453	1837	935547	23
⟨38	062639	1808	997083	25	065556	1833	934444	22
( 39	063724	1804	997068	25	066655	1828	833345	21
⟨40	064806	1799	997053	25	067752	1824	932248	20 2
<b>41</b>	9-065885	1794	9.997039	25	9-068846	1819	10-931154	19
42	066962	1790	997024	25	069938	1815	930062	18
43	068036	1786	997009	25	071027	1810	928973	17 8
44	069107	1781	996994	25	072113	1806	927887	16
45	070176	1777	996979	25	073197	1802	926803	15
46	071242	1779	996964	25	074278	1797	925722	14 }
47	072306	1768	996949	25	075356	1793	924644	13 2
48	073366	1763	996934	25	076432	1789	923568	12 /
49	074424	1759	996919	25	077505	1784	922495	111 )
₹ 50	075480	1755	996904	25	078576	1780	921424	10 2
51	9-076533	1750	9-996889	25	9.079644	1776	10-920356	9 (
52	077583	1746	996874	25	080710	1772	919290	8
53	07/363	1740	996858	25	081773	1767	918227	7 6
54		1738	996843	25	082833	1763	917167	6 6
1 55	079676 080719	1733	996828	25	083891	1759	916109	5 6
56				26	084947	1755	915053	1 4 2
	081759	1729	996812			1751		3
57	082797	1725	996797	26	086000		914000	2
<b>58</b>	083832	1721	996782	26	087050	1747	912950 911902	1 1
59	084864	1717	996766	26 26	088098	1743   1738	911902	1 6
60	085894	1713	996751	· 20	08\$144	1/35		
,-	. Cosine	1	l Sine	1	i Cotang.	1	Tang.	M.

) Sine	D.	Come	D.	Tang.	D.	Cotang.	1
9-085894	1713	9-996751	26	9-069144	1738	10-910856	60
							59 58
							57
089990	1696	996688	26	093302	1722	906698	56
091008	1692	996673	26	094336	1719	905664	55
092024	1688						54
							53
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1							49
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099065	1661	996546	27	102519	1687	897481	47
100062	1657						46
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						894450	44 (
							43 (
							41
105992	1634	996433	27	109559	1661	890441	40 2
9-106973	1630	0-006417	27	0-110556	1658	10-889444	39
107951	1627	996400		111551	1654	888449	38
108927	1623	996384	27	112543		887457	37
							36
							35
							34 (
							32
		996285	28		1629		31
115698	1597	996269	28	119429	1625	880571	30
9-116656	1594	9-996252	28	9-120404	1622	10-879596	29
117613	1590	996235	23	121377	1618	878623	28
118567		996219				877652	27
			28				26
							25
							23
	1569	996134	28	127172	1597	872828	22
124248	1566	996117		128130		871870	21
125187	1569	996100	28	129087	1591	870913	20
9-126125	1559	9-996083		9-130041		10-869959	19
							18
							17
							16
						865216	14
131706	1539	995980	29	135726	1567	864274	13
132630	1535	995963	29	136667	1564	863333	12
133551	1532	995946	29	137605	1561	862395	11
							10
9-135387		9-995911					9
							8 7
							6
	1512		29				5
139944	1509	995823	29	144121	1539	855879	4
140850	1506	995806	29	145044	1535	854956	3
141754	1503	995788		145966	1532	854034	2
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143555	1490		29		. 1250		1 0
Cosine		: Sine		Cotang.		Tang.	] M.
	9-065894 066922 067947 068970 069990 091008 092024 093037 094047 095056 096062 9-097606 099065 100065 100065 100065 101056 102048 103037 104025 105010 105992 9-106973 111842 111849 1118774 111777 115698 9-116656 118567 119519 120469 12141737 115698 9-116656 118567 119519 120469 12141737 115698 9-16656 117613 118567 119519 120469 12141737 119519 120469 12141737 119519 120469 12141737 119519 120469 12141737 119519 120469 12141737 135387 9-196125 127060 127993 1289925 129854 130781 131706 132630 137216 13813837 137216 13813837 137216 13813837 139344	9-085894 1713 069922 1709 069947 1704 069870 1700 069990 1696 091008 1692 092024 1688 093037 1684 094047 1686 095056 1667 096062 1673 9-097065 1668 099065 1661 100062 1653 102048 1653 102048 1649 103037 1644 105010 1638 105992 1634 9-106973 1661 105992 1634 9-106973 1616 111842 1616 111842 1616 111842 1616 111842 1616 111842 1616 111842 1616 111842 1616 1118567 1594 117613 1590 115567 1597 119519 1583 120469 1590 121473 1601 122302 1573 123306 1590 124248 1566 125187 1590 124248 1566 125187 1590 124248 1566 125187 1590 124248 1566 125187 1590 124248 1566 125187 1590 124248 1566 125187 1590 124248 1566 125187 1590 124248 1566 125187 1592 124248 1566 125187 1592 124248 1566 125187 1592 124248 1566 125187 1592 124248 1566 125187 1592 124248 1566 125187 1592 124248 1566 125187 1592 124248 1566 125187 1592 124248 1566 125187 1592 124248 1566 125187 1592 124248 1566 125187 1592 124248 1566 125187 1592 124248 1566 125187 1592 124248 1566 125187 1592 124248 1566 125187 1592 124248 1566 125187 1592 124248 1566 125187 1592 124248 1566 125187 1592 124248 1566 125187 1592	9-085894 1713 9-996751 069922 1709 996735 069924 1704 996730 069970 1700 996704 069990 1696 996685 091008 1692 996673 092024 1688 996687 093037 1684 996641 094047 1690 996625 095056 1676 996615 096062 1673 996594 9-097065 1668 9-996578 096066 1665 996562 099065 1661 996546 100062 1657 996590 101056 1653 996594 102048 1649 996491 100062 1657 996590 101056 1653 996514 102048 1649 996489 103037 1645 996491 105992 1634 996433 9-106973 1630 996491 105992 1634 996433 9-106973 1630 996491 105992 1634 996431 11842 1612 996351 111842 1616 996351 111842 1616 996351 111842 1616 996351 111842 1619 996309 114737 1601 996309 114737 1601 99629 9-11663 1590 996318 113774 1605 996309 114737 1601 996251 115698 1597 996209 9-11650 1596 996185 121417 1576 99619 115519 1583 99629 9-11651 1599 996215 122302 1573 996219 119519 1583 99629 9-11658 1597 996209 9-11659 1580 996185 122316 1590 996185 122302 1573 996191 123306 1569 996185 124148 1566 996114 125187 1568 996100 9-126125 1559 999608 127993 1552 999609 137060 1556 999608 127993 1552 999609 137060 1556 996191 136303 1522 999598 133551 1532 999598 133551 1532 999598 133551 1532 999598 133551 1532 999598 133630 1522 999598 133994 1516 995893 133994 1516 995893 139947 1519 995893 139947 1519 995893 139947 1519 995893 139947 1519 995893 139947 1519 995893 139947 1519 995893 139947 1519 995893 139947 1519 995893 139947 1519 995893 139947 1519 995893 139947 1519 995893 139947 1519 995893 139947 1519 995893 139947 1519 995893 139947 1519 995893 139947 1519 995893 139947 1519 995893 139947 1519 995893 139947 1519 995893 139947 1519 995893 139947 1519 995893 139947 1519 995893 139947 1519 995893 139947 1519 995893 139947 1519 995893	P-085894	P-085894	P-085894	\$\text{Polessed} \

7 W.	Nine Sine	~~ <u>~</u>	Cosine	~~~	Tang.	~~ <u>~</u> ~~	Cotang.	~~
<b>₹</b>	9 143555	1496	9-995753	30	9-147803	1596	10-852197	60 (
(1	144453	1493	995735	30	148718	1523	851282	59 ⟨
( 2	145349	1490	995717	30	149632	1520	850368	58 (
3	146243	1487	995699	30	150544	1517	849456	57 (
<b>{</b> 4 5	147136 148026	1484 1481	995681 995664	30 30	151454 152363	1514 1511	848546 847637	56 6 55 6
8	148915	1478	995646	30	153269	1508	846731	54
\ 7	149802	1475	995628	30	154174	1505	845826	53 }
₹ŝ	150686	1472	995610	30	155077	1502	844923	52 7
₹ ğ	151569	1469	995591	30	155978	1499	844022	51 2
₹ 10	152451	1466	995573	30	156877	1496	843123	50 }
\$ 11	9-1533330	1463	9-995555	30	9-157775	1493	10-842225	49 (
12	154208	1460	995537	30	158671	1490	841329	48 (
5 13	155083	1457	995519	30	159565	1487	840435	47 (
3 14	155957	1454	995501	31	160457	1484	839543	46 (
5 15	156830	1451 1448	995482 995464	31 31	161347 162236	1481	838653	45 (
\ 16 17	157700 158569	1445	995446	31	163123	1479 1476	837764 836877	43 2
₹18	159435	1442	995427	31	164008	1473	835992	42 }
(19	160301	1439	995409	31	164892	1470	835108	41 }
₹20	161164	1436	995390	31	165774	1467	834226	40 2
5 21	9-162025	1433	9-995372	31	9-166654	1464	10-833346	39 ₹
§ 22	162885	1430	995353	31	167539	1461	832468	38 (
5 23	163743	1427	995334	31	168409	1458	831591	37 (
24	164600	1424	995316	31	169284	` 1455	830716	36 \
25	165454	1422	995297	31	170157	1453	829843	35 \
26	166307	1419	995278	31	171029	1450	828971	34 5
27	167159	1416	995260	31 32	171899	1447	828101	33 {
28	168008 168856	1413 1410	995241 995222	32	172767 173634	1444 1442	827233 826366	31 (
30	169702	1407	995203	32	174499	1439	825501	36
31	9-170547	1405		32	9-175362	1436	10-824638	200 }
32	171389	1402	9-995184 995165	32	176224	1433	823776	28
33	172230	1399	995146	32	177084	1431	822916	27 (
34	173070	1393	995127	32	177942	1428	822058	26 5
35	173908	1394	995108	32	178799	1425	821201	25 5
36	174744	1391	995089	32	179655	1423	820345	24 5
37	175578	1388	995070	32	180508	1420	819492	23 >
38	176411	1386	995051	32	181360	1417	818640	22 5
39	177242	1383 1380	995032 995013	32 32	183211 183059	1415 1412	817789 816941	21 20 3
2 40	178072				1			1 ~ 7
41	9 178900	1377	9-994993	32	9-183907	1409	10-816093	19 5
42	179726 180551	1374 1372	994974 994955	32 32	184752 185597	1407 1404	815248 814403	18 }
44	181374	1369	994935	32	186439	1402	813561	165
45	182196	1366	994916	33	187280	1399	812720	1 15 5
46	183016	1364	994896	33	188120	1396	811880	14 >
2 47	183834	1361	994877	33	188958	1393	811042	13 >
48	184651	1359	994857	33	189794	1391	810206	12 >
49	185466	1356	994838	33	190629	1389	809371	111 \
50 خ	186280	1353	994818	33	191462	1386	808538	10 >
₹ 51	9-187092	1351	9-994798	33	9-192294	1384	10-807706	9 (
52	187903	1348	994779	33	193124	1381	806876	8 {
\$ 53	188712	1346	994759	33	193953	1379	806047 805220	6 2
₹ 54 ₹ 55	189519 190325	1343 1341	994739 994719	33 33	194780 195606	1376 1374	804394	5 2
7 56	190325	1338	994719	33	196430	1371	803570	1 4 5
57	191933	1336	994680	33	197253	1369	802747	3
2 58	192734	1333	994660	33	198074	1366	801926	1 2 >
2 59	193534	1330	994640	33	198894	1364	801106	112
60	194332	1328	994620	33	199713	1361	800287	105
ζ-	I Cosine	1	Sine	1	Cotang.	1	Tang.	1 M.

SE.	) Sine		Cosine	~~~~	Tang.	~~~~	Cotang.	~~ <u>)</u>
\ <del>_</del> 0	9-194332	1328	9-994690	33	9 199713	1361	110-800287	- <del>  60</del> {
₹ ĭ	195129	1326	994600	33	200529	1359	799471	59
( 2	105925	1323	994580	33	201345	1356	799655	58 2
( 3	196719	1321	994560	34	202159	1354	797841	57 (
\ <u>4</u>	197511	1318	994540	34	202971	1352	797029	56 (
<b>5</b> 6	198302 199091	1316 1313	994519 994499	34 34	203782 204592	1349 1347	796218	55 (
2 7	199879	1313	994479	34	204392	1345	795408 794600	54 (
Ìė́	200666	1308	994459	34	206207	1342	793793	52
ζğ	201451	1306	994438	34	207013	1340	792987	51 >
( 10	202234	1304	994418	34	207817	1338	792183	50 2
<b>S</b> 11	9-203017	1301	9-994397	34	9-208619	1335	10-791381	49 (
5 18	203797	1299	994377	34	209420	1333	790580	48 (
) 13	204577	1296	994357	34	210220	1331	789780	47 (
) 14	205354	1294	994336	34	211018	1328	788982	46 \
15	206131 206906	1292 1289	994316 994295	34 34	211815 212611	1326 1324	788185 787389	45 5
317	207679	1287	994274	35	213405	1321	786595	44 (
\ is	208452	1285	994254	35	214198	1319	785802	42
S iğ	209222	1282	994233	35	214989	1317	785011	41 2
\$ 20	209992	1280	994212	35	215780	1315	784220	40 €
21	9.210760	1278	9-994191	35	9-216568	1312	10-783432	39 (
22	211526	1275	994171	35	217356	1310	782644	38
23	212291	1273	994150	35	218142	1308	781858	37 5
24	213055	1271	994129	35	218926	1305	781074	36
25	213818	1268 1266	994108	35	219710	1303 1301	780290	35 }
5 20 27	214579 215338	1264	994067 994066	35 35	220492 221272	1299	779508 778728	34 >
) 28	216097	1261	994045	35	222052	1297	777948	33 }
) 29	216854	1259	994024	35	222830	1294	777170	31 3
) 30	217609	1257	994003	35	223606	1292	776394	30 ⟨
₹ 31	9-218363	1255	9-993981	35	9-224382	1290	10-775618	29
( 32	219116	1253	993960	35	225156	1288	774844	28
⟨ 33	219868	1250	993939	35	225929	1286	774071	27 5
34	220618	1248	993918	35	226700	1284	773300	26 \
35	221367	1246	993896	36	227471	1281	772529	25 }
36	222115 222861	1244 1242	993875 993854	36 36	228239 229007	1279 1277	771761 770993	24
₹ 38	223606	1239	993832	36	229773	1275	770227	23 \
(39	224349	1237	993811	36	230539	1273	769461	21
40	225092	1235	993789	36	231302	1271	768698	20 (
<b>41</b>	9-225833	1233	9-993768	36	9-232065	1269	10-767935	19
42	226573	1231	993746	36	232826	1267	767174	1 is 5
3 43	227311	1228	993725	36	233586	1265	766414	17)
\ 44	228048	1226	993703	36	234345	1262	765655	16 >
\ 45 \ 46	228784	1224 1222	993681	36	235103	1260	764897	15
47	229518 230252	1222	993660 993638	36 36	235859 236614	1258 1256	764141 763386	111 2
148	230232	1218	993636	36	237368	1254	762632	13 }
49	231714	1216	993594	37	238120	1252	761880	1115
50	232444	1214	993572	37	238872	1250	761128	iôs
51	9-233172	1212	9-993550	37	9-239622	1248	10-760378	9
52	233899	1209	993528	37	240371	1246	759629	8
53	234625	1207	993506	37	241118	1244	758882	7 ?
₹ 54	235349	1205	993484	37	241865	1242	758135	6 2
<b>∑</b> 55	236073	1203	993462	37	242610	1240	757390	5)
56 57	236795 237515	1201 1199	993440 993418	37 37	243354 244097	1238 1236	756646	4
58	238235	1199	993418	37	244097	1236	755903 755161	3 2
59	238953	1195	993374	37	245579	1232	754421	115
ا 66 \	239670	1193	993351	37	246319	1230	753681	1 65
<b>}</b>	Cosine 1				Cotang.			
レ〜	~~~~·	لحاجہ	Sine	~~~	~~~~	~~~	~~~~·	ر پيول

80 Degrees.

~~~	Sine	~~ <u>~</u>	Coeine	~~~	Tang.	~~ <u>~</u>	Cotang.	7
\ _ 0.	9-239670	1193	9-993351	37	9-246319	1230	10-753681	1 60 (
₹ĭ	240386	1191	993:129	37	247057	1228	752943	59
(2	241101	1189	903307	37	247794	1226	752206	58 5
′, 3	241814	1187	993285	37	248530	1224	751470	57 5
5 4	242526 243237	118 5 118 3	993262 993240	37	249264 249998	1222 1220	750736 750002	56) 55 \
5 6	243947	1181	943217	38	250730	1218	749270	54 \
} 7	244656	1179	993195	38	251461	1217	748539	53 (
} i	245363	1177	993172	38	252191	1215	747809	52 4
(9	246069	1175	993149	38	252920	1213	747080	51 5
(10	246775	1173	993127	38	253648	1211	746352	50 ý
5 11	9-247478	1171	9-993104	38	9-254374	1209	10-745626	49 }
) 12	248181 248883	1169 1167	993081 993059	38 38	255100 255824	1:207 1:205	744900 744176	48 }
\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	249583	1165	993036	38	256547	1203	743453	46
15	250282	1163	993013	38	257269	1201	742731	45 5
(16	250980	1161	992990	38	257990	1200	742010	44 >
(17	251677	1159	992967	38	258710	1198	741290	43 >
5 18	252373 253067	1158	992944 992921	38 38	259429 260146	1196 1194	740571 739854	42 2
19	253067 253761	1156 1154	992921	38	260863	1192	739137	41 }
20	9-254453		9-992875	38	9-261578	1190	10 738422	
21 22	255144	1159 1150	992852	38	262242	1180	737708	39 {
23	255834	1148	992829	39	263005	1187	736995	37 2
5 24	256523	1146	992806	39	263717	1185	736283	36 2
25	257211	1144	992783	39	264428	1183	735572	35 (
26	257898	1142	992759	39 39	265138	1181	734862 734153	34 (
27	258583 259268	1141 1139	992736 992713	39	265847 266535	1179 1178	733445	33 3
28	259951	1139	992713	39	267261	1173	732739	32 5
1 30	260033	1135	992,66	39	267967	1174	732033	30 >
31	9-261314	1133	9-992643	39	9-268671	1172	10-731329	29 (
32	261994	1131	992619	39	269375	1170	730625	28 ₹
33	262673	1130	992596	39	270077	1169	729923	27 (
34	263351	1128	992572	39	270779	1167	729221 728521	26 \$
35	264027 264703	1126 1124	992549 992525	39 39	271479 272178	1165 1164	727822	25 {
30	265377	1122	992501	39	272876	1162	727124	23 2
38	266051	1120	952478	40	273573	1160	726427	22 (
39	266723	1119	9,2454	40	274269	1158	725731	21 (
40	267395	1117	992430	40	274564	1157	725036	20 (
₹41	9-268065	1115	9-992406	40	9.275658	1155	10-724342	19 \$
42	268734	1113	992382	40	276351	1153	723649	18 5
(43	269402	1111	992359 99233 5	40	277043 277734	1151 1150	722957 722266	17 5
44 45	270069 270735	1110 1108	992333	40	278424	1148	721576	16 2
46	271400	1106	992287	40	279113	1147	720687	14 3
47	272064	1105	992263	40	279801	1145	720199	13 5
(48	272726	1103	992:239	40	280488	1143	719512	12 5
(49)	273388	1101	992214	40	281174	1141	718826 718142	1115
(50	274049	1199	992190	40	281858	1140	1	10 {
(51	9.274708	1098	9-992166	40	9·282542 283225	1138	10·717458 716775	9 }
52 53	275367 276024	1096 1094	992142 992117	40	283223	1136 1135	7160:3	8 }
(54	276681	1094	992117	41	284588	1133	715412	65
(55	277337	1091	992069	41	285268	1131	714732	5)
56	277991	1689	992044	41	285947	1130	714053	4 5
57	278644	1087	992020	41	286624	1128	713376	3 }
58	279297	1086	951996	41	287301	1126 1125	712699 712023	2 }
60 S	279948 280599	1084 1082	991971 991947	41	287977 288652	1123	711348	1 6 (
200		100%		41				(
)	Cosine	1	Sine	l .	Cotang.	l	Tang.	LW.

(X)	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		Cosine	~~~	Tang.	~	Cotang.	~
10	9-28059:)	1082	9-991947	1 41	9-288652	1123	10-711348	1 60
1	281248	1081	991922	41	289326	1122	710674	59 2
2	281897	1079	991897	41	289999	1120	710001	58 ?
3	282544	1077	991873	41	290671	1118	709329	57 (
₹ 5	283190	1076	991848	41	291342	1117	708658	56
5 6	283836 284480	1074 1072	991823 991799	41	292013 292682	1115	707987	55 6
5 7	285124	1072	991799	42	292082	1114 1112	707318 706650	53
8	285766	1069	991749	42	294017	1111	705983	52
وک	286408	1067	991724	42	294684	1109	705316	51 >
\$ 10	287048	1066	991699	42	295349	1107	704651	50 }
711	9.287687	1064	9-991674	42	9-296013	1106	10.703987	49 3
} î2	288326	1063	991649	42	296677	1104	703323	48 (
7 13	288964	1061	991624	42	297339	1103	702661	47 (
(14	289600	1059	991599	42	298001	1101	701999	46 (
(15	290236	1058	991574	42	298662	1100	701338	45 (
16	290870	1056	991549	42	299322	1098	700678	44 5
(17	291504	1054	991524	42	299980	1096	700020	43 5
3 18	292137	1053	991498	42 42	300638	1095	699362	42 5
/ 19 } 20	292768 293399	1051 1050	991473 991448	42	301295 301951	1093 1092	698705 698049	41 8
,								1 1
\$ 21 22	9-294029	1048	9-991422	42	9-302607	1090	10-697393 696739	39 5
₹ 23	294658 235286	1046 1045	991397	42 43	303261 303914	1089 1087	696086	38
24	295913	1043	991372 991346	43	304567	1086	695433	36 3
25	296539	1043	991321	43	305218	1084	694782	35 (
26	297164	1040	991295	43	305869	1083	694131	34 (
₹ 27	297788	1039	991270	43	306519	1081	693481	33 (
(28	298412	1037	991244	43	307168	1080	692832	32 (
(29	299034	1036	991218	. 43	307815	1078	692185	31 (
₹ 30	299655	1034	991193	43	308463	1077	691537	30 5
⟨31	9.300276	1032	9-991167	43	9-309109	1075	10.690891	29 5
32	300895	1031	991141	43	309754	1074	690246	28)
33	301514	1029	991115	43	310398	1073	689602	27)
34	302132	1028	991090	43	311042	1071	688958	26 >
35	302748	1026	991064	43	311685	1070	688315	25 >
36	303364	1025	991038	43 43	312327 312967	1068	687673	24 }
38	303979 304593	1023 1022	991012 990986	43	313608	1067 1065	687033 686392	23 }
39	305207	1022	990960	43	314247	1064	685753	21
₹40	305819	1019	990934	1 44	314885	1062	685115	20 5
3 41	9-306430	1017	9-990908	44	9 315523	1061	10:684477	19
3 49	307041	1016	990882	44	316159	1060	683841	18
43	307650	1014	990855	44	316795	1058	683205	17 5
\ 44	308259	1013	990829	44	317430	1057	682570	16 }
45	308867	1011	990803	44	318064	1055	681936	iš >
46	309474	1010	990777	44	318697	1054	681303	14 >
47	310080	1008	990750	44	319329	1053	680671	13 2
48	310685	1007	990724	44	319961	1051	680039	12 2
29	311289	1005	990697	44	320592	1050	679408	117
50	311893	1004	990671	44	321222	1048	678778	10 \$
51	9-312495	1003	9-990644	44	9-321851	1047	10.678149	9 (
∂ 52	313097	1001	990618	44	322479	1045	677521	8
53	313698	1000	990591	44	323106	1044	676894	7,
54	314297	998	990565	44	323733	1043	676267	6 (
55 56	314897	997	990538	44 45	324358	1041	675642	5 4
57	315495 316092	996 994	990511 990485	45 45	324983 325607	1040 1039	675017 674393	3
58	316689	993	990458	45	326231	1039	673769	2
59	317284	991	990431	45	326853	1036	673147	ĩ
60	317879	990	990404	45	327475	1035	672525	1 6 6
}==							Tang.	<u> </u>
لحما		~~~	Sine		Cotang.	~~~	└~ ंःःः.	

M.	Sine		Cosine	D.	Tang.		Cotang.	1
0	9-317879	990	9-990404	45	9-327474	1035	10-672526	60
1 2	318473	988	990378	45 45	328095	1033 1039	671905	59
3	319066 319658	987 986	990351 990324	45	328715 329334	1030	671285 670666	58 57
4	320249	984	990297	45	329953	1029	670047	56
3	320840	983	990270	45	330570	1028	669430	55
6	321430	982	990243	45	331187	1026	668813	54
7	322019	980	990215	45	331603	1025	668197	53
8	322607	979	990188	45	332418	1024	667582	52
9	323194	977	990161	45	333033	1023	666967	51
10	323780	976	990134	45	333646	1021	666354	50
11	9.324366	975	9-990107	46	9-334259	1020	10-665741	49
12	324950	973	990079	46 46	334871	1019	665129 664518	48
13 14	325534 326117	972 970	990052 990025	46	335482 336093	1017 1016	663907	47
15	326700	969	989997	46	336702	1015	663298	45
16	327281	968	989970	46	337311	1013	662689	44
17	327862	966	989942	46	337919	1012	662081	43
18	328442	965	989915	46	338527	1011	661473	42
19	329021	964	989887	46	339133	1010	660867	41
20	329599	962	989860	46	339739	1008	660261	40
21	9-330176	961	9-989832	46	9-340344	1007	10-659656	39
22	330753	960	989804	46	340948	1006	659052	38
23	331329	958	989777	46	341552	1004	658448	37
24	331903	957	. 989749	47	342155	1003	657845	36
25	332478	956	989721	47	342757	1002	657243	35
26	333051	954	989693	47	343358	1000	656642	34
27	333624	953	989665	47	343958	7999	656042	33
28 29	334195	952	989637 989609	47	344558 345157	998 997	655442 654843	32
30	334766 335337	950 949	989582	47	345755	996	654245	30
31	9:335906	948	9-989553	47	9-346353	994	10.653647	29
32	336475	946	989525	47	346949	993	653051	28
33	337043	945	989497	47	347545	992	652455	27
34	337610	944	989469	47	348141	991	651859	26
35	338176	943	989441	47	348735	990	651265	25
36	338742	941	989413	47	349329	988	650671	24
37	339306	940	989384	47	349922	987	650078	23
38	339871	939	989356	47	350514	986	649486	22
39	340434	937	989328	47	351106	985	648894	21 20
40	340996	936	989300	47	351697	983	648303	1
41	9-341558	935	9-989271	47	9-352287	982	10 647713	19
42	342119	934	989243	47	352876	981	647124	18
43	342679	932	989214	47	353465	980	- 646535 645947	17
44 45	343239	931 930	989186 989157	47	354053 354640	979 977	645360	15
46	343797 344355	930	989137	48	354040 355227	976	644773	14
47	344912	929	989100	48	355813	975	644187	13
48	345469	926	989071	48	356398	974	643602	12
49	346024	925	989042	48	356982	973	643018	11
50	346579	924	989014	48	357566	971	642434	10
51	9-347134	922	9-988985	48	9-358149	970	10-641851	9
52	347687	921	988956	48	358731	969	641269	B
53	348240	920	988927	48	3 59313	968	640687	7
54	348792	919	988898	48	359893	967	640107	6
55	349343	917	988869	48	360474	966	639526	5
56	349893	916	988840	48	361053	965	638947	4
57	350443	915	988811	49	361632	963	638368	3
58	350992	914	988782	49	362210	962	637790	2
59 60	351540	913	988753 988724	49	362787 363364	961 960	637213 636636	١٥
œ	352088	911	BOO (2/4)	-20	200004	. 200	. מאנונאט	.0

77 Degrees.

M.	~~ Sine '	~~~~	Cosine	~~~~~	Tang.	~~~~	Cotang.	<u>`~</u>
0	9-352088	911	9-988724	49	9-363364	960	10.636636	60
1	352635	910	988695	49	363940	959	636060	59
2 3	353181	909	988666	49	364515	958 957	635485	58
	353726	908	988636	49	365090	957 955	634910	57
4	354271	907	988607	49 49	365664 366237	954	634336 633763	56 55
5	354815	905 904	988578 988548	49	366810	953	633190	54
6	355358 355901	903	988519	49	367382	952	632618	53
é	356443	903	988489	49	367953	951	632047	52
9	356984	901	988460	49	368524	950	631476	51 5
10	357524	899	988430	49	369094	949	630906	50 5
)		898	9-988401	49	9-369663	948	10-630337	49 5
11	9-358064	897	988371	49	370232	946	629768	48
12 13	358603 359141	896	988342	49	370799	945	629201	47
14	359678	895	988312	50	371367	944	628633	46
15	360215	893	988282	50	371933	943	628067	45
16	360752	892	988252	50	372499	942	627501	44)
(îř	361287	891	988223	50	373064	941	626936	43)
18	361822	890	988193	50	373629	940	626371	42)
19	362356	889	988163	50	374193	939	625807	41 >
20	362889	888	988133	50	374756	938	625244	40 }
21	9.363422	887	9-988103	50	9-375319	937	10-624681	39 8
22	363954	885	988073	50	375881	935	624119	38 (
23	364485	884	988043	50	376442	934	623558	37 (
24	365016	883	988013	50	377003	933	622997	36 (
25	365546	882	987983	50	377563	932	622437	35 (
26	366075	881	987953	50	378122	931	621878	34 (
27	366604	880	987922	50	378681	930	621319	33 (
28	367131	879	987892	50	379239	929	620761	32 (
29	367659	877	987862	50	379797	928	620203	31 (
30	368185	876	987832	51	380354	927	619646	30 (
31	9-368711	875	9-987801	51	9-380910	926	10-619090	29 \$
32	369236	874	987771	51	381466	925	618534	28 5
33	369761	873	987740	51	382020	924	617980	27 5
34	370285	872	987710	51	382575 383129	923 922	617425	26 5
35 36	370808	871	987679	51 51	383682	923	616871 616318	25 8
37	371330	870 869	987649 987618	51	384234	920	615766	23 (
38	371852 372373	867	987588	51	384786	919	615214	22 (
39	372894	866	987557	51	385337	918	614663	21 (
40	373414	865	987526	51	385888	917	614112	20 ⟨
41	9-373933	864	9-987496	51	9-386438	915	10-613562	19
42	374452	863	987465	51	386987	914	613013	18 5
43	374970	862	987434	51	387536	913	612464	17 5
44	375487	861	987403	52	388084	912	611916	16 5
45	376003	860	987372	52	388631	911	611369	15 5
46	376519	859	987341	52	389178	910	610822	14 5
47	377035	858	987310	52	389724	909	610276	13 5
48	377549	857	987279	52	390270	908	609730	12 5
49	378063	856	987248	52	390815	907	609185	111 5
(50	378577	854	987217	52	391360	906	608640	10 \$
51	9-379089	853	9-987186	52	9.391903	905	10-608097	9)
52	379601	852	987155	52	392447	904	607553	8 2
53	380113	851	987124	52	392989	903	607011	1 7 2
54	380624	850	987092	52	393531	902	606469	6 6
55	381134	849	987061	52	394073	901	605927	5 6
56	381643	848	987030	52	394614	900	605386	4 3
57	382152	847	986998	52	395154	899	604846	1 3 (
58	382661	846	986967	52 52	395694 396233	898 897	604306 603767	2 2
59 60	383168 383675	845 844	986936 986904	52	396771	896	603229	165
		044		. 52				
1	1 Cosine	l	Sine	l	Cotang.	1	Tang.	M.

76 Degrees.

(<u>m</u>	8ine	~~~~~	Cosine		Tang.	~~~	Cotang.	~~
₹ 0	9-383675	844	9-986904	59	9-396771	896	10-603229	60 (
ŀΪ	384182	843	966873	53	397309	896	602691	59 \
(; 2	384687	842	986841	. 53	397846	895	602154	58 ⟨
}-3	385192	841	996809	53	398383	894	601617	57 (
₹	385697	840	986778	53 53	398919	893 892	601081 600545	56 d
<u>(</u> , 5	386201 386704	839 838	986746 986714	53	399455 399990	891	600010	35 (54)
\$ 6 7	387207	837	986683	53	400524	890	599476	53 /
}. å	387709	836	986651	53	401058	889	598942	52
) 9	388210	835	966619	53	401591	888	598409	51 >
} 1ŏ	388711	834	986587	53	402124	887	597876	50 2
C 11	9-389211	833	9-986555	53	9-402656	886	10'597344	49 ₹
(12	389711	832	986523	53	403187	885	596813	48 (
(13	390210	831	986491	53	403718	884	596282	47 3
(14	390708	830	986459	53	404249	883	595751	46 (
(15	391206	828	986427	53	404778	882	595222	45 (
(16	391703	827	986395	53 54	405308	881	504692	44 4
\$ 17	392199	826	986363	54 54	405836	880 879	594164 593636	42
§ 18 19	392695 393191	825 824	986331 986299	54	406364 406892	878	593108	41 2
20	393685	823	986266	54	407419	877	592581	40 2
)			1	54	9-407945	876	10-592055	39 (
\$ 21 22	9·394179 394673	822 821	9-986234 986202	54	408471	875	591529	38 (
₹ 23	395166	820	986169	54	408997	874	591008	37 (
ζ 24	395658	819	986137	54	409521	874	590479	36 (
¢ 25	396150	818	986104	54	410045	873	589955	35 (
₹ 26	396641	817	986072	54	410569	872	589431	34 (
\$ 27	397132	817	986039	54	411092	871	588908	33 〈
5 28	397621	816	986007	54	411615	870	588385	32 (
S 29	398111	815	985974	54	412137	869	587863	31 (
∫ 30	398600	814	985942	54	412658	868	587342	30 (
31	6-399068	813	9-985909	55	9.413179	867	10-586821	29 5
32	399575	812	985876	55 55	413699	866 865	586301 585781	28 2
33	400062	811 810	985843 985811	55	414219 414738	864	585262	26 3
35	400549 401035	809	985778	55	415257	864	584743	25 (
36	401520	808	985745	55	415775	863	584225	24 (
37	402005	807	985712	55	416293	862	583707	23 (
₹38	402489	806	985679	55	416810	861	583190	22 (
39	402972	805	985646	55	417326	860	582674	21 (
5 40	403455	804	985613	55	417842	859	582158	20 {
41	9.403938	803	9-985580	55	9-418358	858	10-581642	19)
42	404420	802	985547	55	418873	857	581127	18)
43	404901	801	985514	55	419387	856	580613	17)
2 44	405382	800	985480	55	419901	855	580099	16)
45	405862	799	985447	55 56	420415	855 854	579585 579073	15 \
\ 46 \ 47	406341	798 797	985414 985380	56	420927 421440	854 853	578560	13 3
3 48	406820 407299	796	985347	56	421952	852	578048	12 4
\$ 49	407777	795	985314	56	422463	851	577537	ii s
50	408254	794	985290	56	422974	850	577026	10 5
51	9.408731	794	9-985247	56	9-423484	849	10.576516	9 5
52	409207	793	985213	56	423993	848	576007	8)
53	409682	792	985180	56	424503	848	575497	7)
54	410157	791	985146	56	425011	847	574989	6)
2 55	410632	790	985113	56	425519	846	574481	5)
2 56	411106	789	985079	56	426027	845	573973	4 2
2 57	411579	788	985045	56	426534	844	573466	3 2
₹ 58	412052	787	985011	56	427041	843	572959 572453	1 2 3
59	412524	786	984978 984944	56 56	427547 428052	843 842	572453	6 3
3 60	412996	785				0926		
(Cosing	1	Sine	1	Cotang.	L	Tang.	[₩. ⟨

1 413467 7294 984910 57 42,3462 840 571433 59 2 419938 783 984874 57 42,3462 840 570368 58 3 414408 783 984874 57 42,366 829 570434 57 4 414678 782 984898 57 430070 838 56930 56 5 415347 781 984774 57 430573 838 569427 55 6 415347 781 98474 57 431575 837 568825 54 15347 781 98474 57 431575 836 568423 53 8 416751 778 984676 57 431575 836 568423 53 8 416751 778 984673 57 432579 835 567921 52 2 418616 775 984637 57 432590 832 566420 50 11 9418150 775 984560 57 9433580 832 10*566420 43 2 418615 774 984535 57 434579 831 565421 47 3 419079 773 984500 57 434579 831 565421 47 4 41934 773 984500 57 434579 831 565421 47 4 41934 773 984506 57 43579 831 565421 47 4 41934 773 984506 57 43579 831 565421 47 4 420007 772 984432 58 435576 829 564424 45 4 41954 773 984508 57 43677 828 56330 43 8 421395 769 984328 58 435576 829 564424 45 6 420170 771 984337 58 436673 828 563320 43 8 421395 769 984328 58 437667 828 563320 43 8 421395 769 984259 58 436570 828 563320 43 8 42238 766 984190 58 43658 825 561414 40 422318 767 984259 58 43658 825 561414 40 422318 767 984259 58 43658 825 56141 40 422318 766 984190 58 43048 823 560457 37 6 42238 766 984190 58 43068 821 559664 39 6 422577 765 984155 58 43658 825 561941 40 6 42669 757 765 984155 58 43658 825 561941 40 6 42669 757 765 984155 58 43658 825 561941 40 6 42669 757 765 984155 58 43658 821 55964 39 6 426415 763 984085 58 441022 820 558978 34 6 42615 763 984085 59 444947 818 557503 31 6 42697 755 983846 59 444947 818 557501 31 6 42697 755 983846 59 444988 817 55701 20 6 42643 769 985352 59 444986 816 556052 28 6 42665 764 984120 58 440968 816 556052 28 6 42665 764 98432 59 448586 800 10.556621 29 6 426463 769 983861 59 445976 818 557503 31 6 426977 765 98495 59 444947 818 557503 31 6 426977 765 98495 59 444948 810 55367 24 6 426987 765 98495 59 444986 816 556052 29 6 42663 766 98496 59 44986 80 556047 37 6 42669 77 6 42669 77 77 78 98437 78 98486 60 45566 77 78 98486 77 78 98486 77 78 98486 77 78 98486 77 78 98486 77 78 98486 77 78 98486 77 78 98486 77 78 98486 77 78 98486 77 78 9848	M.	Sine		Cosine) D.	Tang.			1
2 413938 723 984870 57 42,0462 840 570338 58 3 414408 782 984808 57 42,0566 839 570434 57 4 414678 782 984808 57 42,0573 838 569420 56 5 415347 781 984774 57 43,073 838 569420 56 6 415815 780 984706 57 43,1577 836 568423 53 8 416751 778 984603 57 432580 834 567420 51 9 417684 776 984633 57 432580 834 567420 51 1 9418150 77.5 984335 57 43460 832 10°56620 40 2 418615 773 984466 57 435078 801 565421 47 4 41954 773 984466 <td>0</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>60</td>	0								60
3 414408 723 984842 57 42,9566 829 570434 57 4 414678 722 984808 57 430070 838 569300 56 5 415347 781 984740 57 430573 838 569427 55 6 415815 780 984740 57 431577 836 568423 53 8 416751 778 984603 57 432079 815 567420 51 9418150 775 984503 57 433080 833 56090 50 11 9418150 775 984500 57 9433880 832 10°506420 49 23 419079 773 984500 57 434579 831 565421 47 45 420007 771 984307 58 43576 829 564424 45 47 420933 770 984328 8									
4 414878 7892 884808 57 430070 838 569,900 56 5 415347 781 984774 57 420373 838 569,927 55 6 415815 780 984706 57 431075 837 568423 53 7 416283 779 984706 57 431077 805 568423 53 8 416751 777 984637 57 432080 834 567420 51 9 417884 776 984637 57 432080 832 565420 51 1 9418150 775 9984509 57 9433580 832 10°56420 49 2 418015 774 984533 57 9433580 832 10°56420 49 2 418079 773 984406 57 435078 801 565420 48 2 420170 771 9843									
5 415347 781 984774 57 420573 838 569427 55 6 418815 780 984740 57 431075 837 568025 54 6 418815 7780 984710 57 431075 837 568023 53 8 416751 778 984672 57 432079 805 568423 53 9 41784 776 984603 57 432080 832 566200 50 12 418615 774 984509 57 9433580 832 1056420 49 12 418615 774 984500 57 434080 832 1056420 40 419079 771 984303 58 435676 829 564424 45 420907 771 984303 58 435670 828 563300 43 421933 770 984328 58 43767									
6 418815 780 984740 57 431075 837 568825 54 7 416283 779 984706 57 431577 830 568423 53 8 416751 778 984672 57 432079 835 567420 51 9 417817 7777 984637 57 432080 834 567420 51 1 9418150 775 9984569 57 9433580 832 10°56620 48 2 418015 773 984466 57 434579 831 505421 47 4 419544 773 984466 57 435073 820 564922 46 6 420470 771 984307 58 436570 828 563927 44 4 419544 77 984303 58 437067 828 563327 42 6 420470 771 984307 <td>4</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>	4								
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8 410751 778 984672 57 432079 835 567421 52 9 417817 777 984637 57 432580 834 567420 51 1 9418150 775 984603 57 433080 832 10°56420 49 2 418615 774 984535 57 434600 832 565420 48 2 418615 774 984535 57 434579 831 565421 47 3 419079 773 984466 57 43578 800 561422 46 4 419544 773 984466 57 43578 800 561424 45 6 420170 771 984397 58 436570 828 56330 74 421933 770 984294 58 437667 827 56233 43 81 9421857 708 984294 58	. 0								
9 417217 777 984637 57 432580 834 567420 51 10 9418150 775 984603 57 433080 833 566920 50 22 418615 774 984535 57 434080 832 505920 48 419079 773 984500 57 434579 831 565421 47 4 419079 773 984466 57 435078 801 565421 47 4 419544 773 984466 57 435078 809 564424 45 5 420007 771 984363 58 436570 828 563237 44 7 429933 770 984329 58 437667 827 56293 564374 41 9 422187 767 984259 58 437663 86 562437 41 10 92218 767 984259 <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>									
0 417684 776 984603 57 433080 833 566920 50 1 9418150 775 994369 57 943380 832 10'506490 49 2 418615 774 984535 57 434080 832 505420 48 3 419079 773 984500 57 434579 831 505421 47 4 419544 773 984432 58 435073 820 564424 45 5 420007 771 984397 58 436073 828 563327 44 7 420333 770 984328 58 437667 827 502933 42 8 421857 768 984294 58 437663 826 562347 41 90 421857 768 984155 58 430539 823 5609437 41 91 9422778 767 984259<									
11 9-418150 775 9-84569 57 9-333580 802 10'506420 49 418015 774 984535 57 434080 802 505320 48 434079 773 984450 57 434579 801 505421 47 419544 773 984466 57 435073 801 505421 47 419544 773 984466 57 435073 800 504922 46 420007 771 984397 58 435576 829 504424 45 66 420470 7711 984397 58 436570 828 563397 44 728218 770 984363 58 430570 828 563397 44 728218 770 984363 58 430570 828 563397 44 728218 770 984398 58 430570 828 563430 43 77 421857 708 984294 58 437663 826 562437 41 8042218 767 984259 58 430583 825 562437 41 8042218 767 984259 58 43068 822 5051941 40 81 9422778 768 984190 58 43068 823 500457 37 81 84 84 84 84 84 84 84 84 84 84 84 84 84									
12	10		1					1	ľ
33 419079 773 984500 57 434579 831 565421 47 44 419544 773 984466 57 435073 820 564922 46 55 420007 771 984392 58 435576 829 564424 45 66 420470 771 984393 58 436570 828 563397 44 77 420933 770 984328 58 437667 827 569333 42 88 421395 769 984328 58 437667 827 569333 42 80 422318 767 984294 58 437667 827 569333 42 80 422318 767 984224 58 9-38554 824 10·561446 39 81 424278 765 984155 58 439543 823 560457 37 424156 764 984120 <	11								
4 418544 773 984406 57 425078 820 564922 46 5 6 420007 771 984432 58 435576 829 564424 45 6 420470 771 984303 58 436570 828 563927 44 7 420933 770 984303 58 430570 828 563927 41 9 421857 708 984294 58 437663 896 562437 41 9 422318 767 984259 58 430639 825 561941 40 10 422318 766 984190 58 430648 823 500457 37 22 423238 766 984190 58 430488 823 500457 37 24 424156 764 984120 58 440036 822 55964 36 25 425073 762 984050 <td>12</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>	12								
55 420007 772 984432 58 435576 829 564424 45 67 420470 771 984397 58 436073 828 563927 44 67 420933 770 984328 58 43767 827 502433 42 60 422318 767 984259 58 437637 825 561941 40 60 422318 767 984259 58 436059 825 561941 40 61 9422778 707 9984224 58 9438554 824 10*561446 39 62 422338 766 984190 58 439048 823 500457 37 63 424156 764 984155 58 439543 823 500457 37 64 425587 760 984965 58 441032 823 559671 35 67 425530 761	13								
66 429470 771 984307 58 436073 828 563927 44 7.8 429933 770 984363 58 436570 828 563390 43 7.8 4219857 708 984294 58 437067 827 562933 42 9.9 42218 767 984295 58 43763 825 561941 40 1.1 9422778 767 9984224 58 9438554 824 10·561446 39 2.1 2429238 766 984190 58 439048 823 560437 41 2.2 42397 765 984155 58 439548 823 560457 36 2.2 424156 764 984120 58 440036 822 55964 39 2.6 425073 762 984950 58 4410529 821 559471 35 2.6 425087 700	14								
77	15								
8 421395 760 984328 58 427067 827 562933 42 90 4221857 708 984294 58 437563 896 562437 41 90 422318 767 984259 58 438059 825 501941 40 91 942278 766 984190 58 43048 823 501951 41 52 423287 766 984190 58 43048 823 50052 38 52 424615 763 984085 58 440328 823 560457 37 54 424156 763 984085 58 440329 821 559471 35 55 424615 763 984085 58 441052 821 559471 35 67 425530 761 984050 58 441052 820 558486 33 68 425987 700 983961 </td <td>16</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>	16								
9 421887 768 984294 58 437563 825 561941 40 11 9422178 767 984259 58 43659 825 561941 40 12 9422178 767 984259 58 9436554 824 10·561446 39 12 423238 766 984190 58 439048 823 500457 37 13 424156 764 984120 58 440036 822 55964 36 15 424615 763 984085 58 440036 822 55964 36 16 425073 762 984050 58 441022 820 558478 34 17 425530 761 984015 58 4411614 819 557994 32 19 427354 758 9983875 58 9443479 818 557503 31 10 927354 758	17								
80 422318 767 984259 58 43e059 825 561941 40 11 9422778 767 984259 58 9-38554 894 10·561446 39 22 423238 766 984190 58 439048 823 560457 37 34 424156 764 984190 58 440036 823 560457 37 34 424156 763 984085 58 440036 822 559664 39 36 425073 760 984050 58 441022 820 558486 34 37 425530 761 984015 58 441514 819 557848 34 38 425987 760 983861 58 442968 817 557033 31 40 426899 759 983911 58 442988 817 557012 30 41 427809 757	18								
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21	9-449485	717	9-982072	62	9-467413	779	532120	38
222	449915	716	982035	62	467890 468347	778 778	531653	37 5
∑ 23	450345	716 715	981998	62	468814	1777	531186	36
24	450775 451204	714	981961 981924	62	469280	776	530720	35 >
26	451632	713	981886	62	469746	775	530254	34
\ 27 27	452060	713	981849	62	470211	775	529789	33 >
\$ 28	452488	712	981812	62	470676	774	529324	32)
29	452915	711	981774	62	471141	773	528859	31)
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31	9-453768	710	9-981699	63	9-472068	772	10-527932	29 (
32	454194	709	981662	63	472532	771	527468	28 ₹
33	454619	708	981625	63	472995	771	527005	27 (
34	455044	707	981587	63	473457	770	526543	26
35	455469	707	981549	63	473919	769	526081	25 (
36	455893	706	981512	63	474381	769	525619	24 (
37	456316	705	981474	63	474842	768	525158	23 (
38	456739	704	981436	63	475303	767	524697	22 (
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49	461364	696	981019	64	480345	760	519655	110 2
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51	9-462199	695	9-980942	64	9-481257	759	10-518743	9)
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2	490759	647	978124	68	512635	715	487365	58 (
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4	491535	646	978042	69	513493	714	486507	56 (
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6	492308	644	977959	69	514349	713	485651	54 2
7	492695	644	977918	69	514777	712	485223	53 2
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12	494621	641	977711	69	516910	709	483090	
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14	495388	639	977628	69	517761	708	482665	47 5
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21	9-498064	635	9-977335	70	9-520728	704	10-479272	39 >
22	498444	634	977293	70	521151	703	478849	38 >
23	498825	634	977251	70	521573	703	478427	37 >
24	499204	633	977209	70	521995	703	478005	36 ;
25	499584	632	977167	70	522417	702	477583	35 >
26	499963	632	977125	70	522838	702	477162	34 5
27	500342	631	977083	70	523259	701	476741	33 >
28	500721	1 001	977041	70	523680	701	476320	32 >
29	501099	630	976999	70	524100	700	475900	31)
30	501476	629	976957	70	524520	699	475480	30)
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₹ 32	502231	628	976872	71	525359	698	474641	28 }
₹ 33	502607	628	976830	71	525778	698	474222	27
34	502984	627	976797	71	526197	697	473803	26 >
35	503360	626	976745	71	526615	697	473385	25 >
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37	504110	625	976660	71	527451	696	472549	23 /
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42	505981	622	976446	71	529535	693	470465	18
43	506354	622	976404	71	529950	693	470050	177
44	506727	621	976361	71	530366	692	469634	16
45	507099	620	976318	71	530781	691	469219	15 2
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54	510434	615	975930	72	534504	687		75
55	510803	615	975887	72	534916	686	465496	65
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22	541613	567	971964	78	569648	645	430352	38 ∫
23	541953	566	971917	78	570035	645	429965	37 5
24 25	542293	566	971870	78	570422 570809	644	429578 429191	36 {
26	542632 542971	565 565	971823	7E 78	571195	644 643	425805	32)
27	543310	564	971776 971729	79	571581	643	428419	34 \ 33 \
28	543649	564	971682	79	571967	642	429033	32 (
29	543987	563	971635	79	572352	642	427648	31 (
30	544325	563	971588	79	572738	642	427262	36 ₹
31		562		79	9-573123	1	10-426877	29 }
32	9-544663	562	9-971540	79	573507	641 641	426493	28
33	545000 545338	561	971493 971446	79	573892	640	426108	27 5
34	545674	561	971398	79	574276	640	425724	26
35	546011	560	971351	79	574660	639	425340	25
36	546347	560	971303	79	575044	639	424956	24 5
37	546683	559	971256	79	575427	639	424573	23 5
38	547019	559	971208	79	575810	638	424190	22
39	547354	558	971161	79	576193	638	423807	21 5
40	547689	558	971113	79	576576	637	423424	205
41	9-548024	557	9-971066	80	9-576958	637	10-423041	19
42	548359	557	971018	80	577341	636	422659	185
43	548693	556	970970	80	577723	636	422277	175
44	549027	556	970922	80	578104	636	421896	16 5
45	549360	555	976874	80	578486	635	421514	15 5
46	549693	555	970827	80	578867	635	421133	14 >
47	550026	554	970779	80	579248	634	420752	13 >
48	550359	554	270731	80	579629	634	420371	12 >
49	550692	553	970683	80	580009	634	419991	11)
) 50	551024	553	970635	80	580389	633	419611	10)
₹ 51	9-551356	552	9-970586	80	9-580769	633	10-419231	9 2
52	551687	552	970538	80	581149	632	418851	š}
(53	552018	552	970490	80	581528	632	418472	7 7
₹ 54	552349	551	970442	80	581907	632	418093	6 6
₹ 55	552680	551	970394	80	582286	631	417714	5 ?
₹ 56	553010	550	970345	81	582665	631	417335	4 ?
₹ 57	553341	550	970297	81	583043	630	416957	3 (
₹ 58	553670	549	970249	81	583422	620	416578	2 (
59	554000	549	970200	81	583800	629	416200	1 1 (
<u>60</u>	554329	548	970152	81	584177	629	415823	<u>' 0</u> {
	Cosine	1	Sine	1	Cotang.	1	Tang.	M.)
\sim	~~~	~~~	~~~~		~~~~		ベヘヘズへ	$\sim\sim$ \sim

69 Degrees.

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(M.				D.) D.	Cotman.	<u> </u>
0	9-554329	548	9-970152	81	9-584177	629	10-415823	60 (
} 1 2	554658 554987	548 547	970103 960055	81 81	584555 584932	629 628	415445 415068	59
3	555315	547	970006	l si	585309	028 628	413068 414691	58 { 57 {
5 4	555643	546	969957	8i	585686	627	414314	56 ₹
) 5	555971	546	969909	81	586062	627	413938	55 (
) 6	556299	545	969860	81	586439	627	413561	54 \
2 7	556626	545	969811	81	586815	626	413185	53 (
} 8	556953 557280	544 544	969762 969714	81 81	587190 587566	626 625	412810 412434	52 (51 (
3 10	557606	543	969665	81	587941	625	412059	50 2
/ 11	2 557932	543	9-969616	82	9-588316	625	10-411684	49 }
} i2	558258	543	969567	82	588691	624	411309	48 5
∂ iã	558583	542	969518	82	589066	624	410934	47 5
14	558909	542	969469	82	589440	623	410560	46 >
₹ 15	559234	541	969420	82	589814	623	410186	45 >
\ 16 17	559558 559883	541 540	969370 969321	82 82	590188	623 622	409812 409438	44 \
18	560207	540	969272	82	590562 590935	622	409065	42
7 19	560531	539	969223	82	591308	622	408692	41 5
20	560855	539	969173	82	591681	621	408319	40 5
₹21	9-561178	538	9-969124	82	9-592054	621	10-407946	39 >
(22	561501	538	969075	82	592426	620	407574	38∤
(23	561824	537	969025	82	592798	620	407202	37 ₹
(24	562146	537	968976	82	593170	619	406829	36 ⟨
25	562468 562790	536 536	968926 968877	83 83	593542 593914	619 618	406458 406086	35 }
27	563112	536	968827	83	594285	618	405715	33 >
₹ 28	563433	535	968777	83	594656	618	405344	362 >
₹ 29	563755	535	968728	83	595027	617	404973	31 2
(30 ⋅	564075	534	968678	83	595398	617	404602	30 {
5 31	9-564396	534	9-968628	83	9-595768	617	10-404232	29
32	564716	533	968578	83	596138	616	403862	28 (
\{\}33 34	565036 565356	533 532	968528 968479	83	596508	616 616	403492 403122	27 (26 (
7 35	565676	532	968429	83	596878 597247	615	402753	25
₹36	565995	531	968379	83	597616	615	402384	24
⟨ 37	566314	531	968329	83	597985	615	402015	23 (
⟨ 38	566632	531	968278	83	598354	614	401646	22 (
39	566951	530	968228	84 84	598722	614	401278	21 5
40	567269	530	968178		599091	613	400909	20 5
41	9-567587	529 529	9-968128 968078	84	9-509459	613	10-400541	19
43	567904 568222	529	968027	84 84	599827 600194	613 612	400173 399806	18 \
\ 44	568539	528	967977	84	600562	612	399438	16 3
345	568856	528	967927	84	600929	611	399071	iš s
5 46	569172	527	967876	84	601296	611	398704	14 5
5 47	569488	527	967826	84	601662	611	398338	13 }
\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	569804 570120	526 526	967775 967725	84 84	602029	610 610	397971	12 \
\ 50	570120	525	967674	84	602395 602761	610	397605 397230	16 3
51	9.570751	525	9-967624	84	9-603127	609	10-396873	9}
52	571066	524	967573	84	603493	609	396507	85
53	571380	524	967522	85	603858	609	396142	75
54	571695	523	967471	85	604223	608	395777	6
55	572009	523	967421	85	604588	608	395412	5 }
2 56	572323	523	967370	85	604953	607	395047	4 ₹
57 58	572636 572950	522 522	967319 967268	85 85	605317	607 607	394683	3 >
59	572950 573263	521	967217	85	605682 606046	606	394318 393954	2 }
\$ 60	573575	521	967166	85	606410	606	393590	lős
5-	Cosine	 -	1 Sine		I Cotang.		I Tang.	1 ML {

(M.)	Sine	~~ <u>`</u> D. ~	Comme	~~~~	Tang.	~~~~	Cotang.	~~		
50	9-573575	521	9-967166	85	9-606410	606	10.393590	60		
1	573888	520	967115	85	606773	606	393227	59 }		
2	574200	520	967064	85	607137	605	392863	58)		
3	574512 574824	519	967013	85	607500 607863	605 604	392500	57		
\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	575136	519 519	966961 966910	85 85	608225	604	392137 391775	56 2		
₹ 6	575447	518	966859	85	608588	604	391412	54 5		
(7	575758	518	966808	85	608950	603	391050	53 5		
(8	576069	517	966756	86	609312	603	390688	52		
5 9	576379	517	966705	86	609674	603	390326	51 >		
5 10	576689	516	966653	86	610036	602	389964	50 >		
11	9.576999	516	9.966602	86	9.610397	602	10.389603	49 2		
2 12	577309	516	966550	86	610759	602	389241	48 (
) 13	577618 577927	515	966499 966447	86 86	611120	601 601	388880	47 }		
S 13	578236	515 514	966395	86	611480 611841	601	388520 388159	46 /		
16	578545	514	966344	86	612201	600	387799	44 >		
) 17	578853	513	966292	86	612561	600	387439	43		
5 18	579162	513	966240	86	612921	600	387079	42		
) 19	579470	513	966188	86	613281	599	386719	41 }		
20	579777	512	966136	86	613641	599	3 86359	40 2		
21	9-580085	512	9 966085	87	9-614000	598	10-386000	39 (
22	580392	511	966033	87	614359	598	385641	38 (
24	580699 581005	511 511	965981 965928	87	614718 615077	598	385282	37 (
25	581312	510	965876	87 87	615435	597 597	384923 384565	36 (
26	581618	510	965824	87	615793	597	384207	34 2		
27	581924	509	965772	87	616151	596	383849	33 ₹		
} 28 ∣	582229	509	965720	87	616509	596	383491	32 (
29	582535	509	965668	87	616867	596	383133	31 (
30	582840	508	965615	87	617224	595	382776	30 ⟨		
(31	9.583145	508	9.965563	87	9.617582	595	10-382418	29 5		
32	583449	507	965511	87	617939	595	382061	28 5		
33 34	583754 584058	507 506	965458	87	618295	594	381705	27		
35	584361	506	965406 965353	87 88	618652 619008	594 594	381348 380992	26 \		
₹ 36	584665	506	965301	88	619364	593	380636	24 \		
(37	584968	505	965248	88	619721	593	380279	23 (
⟨38	585272	505	965195	88	620076	593	379924	22 \		
39	585574	504	965143	88	620432	592	379568	21 5		
ζ 40	585877	504	965090	88	620787	592	379213	20 5		
, 41	9-586179	503	9-965037	88	9-621142	592	10.378858	19 }		
242	586482	503	964984	88	621497	591	378503	18 }		
43	586783 587085	503 502	964931 964879	88 88	621852 622207	591 590	378148	17 16		
₹ 45	587386	502	964826	88	622561	590 590	377793 377439	15		
46	587688	501	964773	88	622915	590	377085	14 5		
\$ 47	587989	501	964719	88	623269	589	376731	13 5		
5 48	588289	501	964666	89	623623	589	376377	12 \$		
49	588590	500	964613	89	623976	589	376024	11 }		
50	588890	500	964560	89	624330	588	3 75670	10 }		
51	9-589190	499	9.964507	89	9-624683	588	10-375317	9)		
52	589489	499	964454	89	625036	588	374964	8 (
53	589789 590088	499 498	964400 964347	89 89	625388 625741	587	374612 374259	6		
55	590387	498	964294	89	626093	587 587	374259 373907	5		
56	590686	497	964240	89	626445	586	373555	45		
57	590984	497	964187	89	626797	586	373203	3)		
58	591282	497	964133	89	627149	586	372851	2 >		
59	591580	496	964080	89	627501	585	372499	1 1 2		
\ <u>60</u>	591878	496	964026	89	627852	585	372148	<u>· o</u> }		
۲.	Cosine Sine Cotang. Tang.									

67 Degrees.

(M.	Sine	~~~~	Coeine	~~~	Tang.		Cotang.	~~~
> 0	9-591878	496	9-964026	89	9-627852	585	10.372148	60
) 1	592176	495	963972	89	628203	585	371797	59
) 2	592473	495	963919	89	628554	585	371446	58 2
3 4	592770 593067	495	963865	90	628905	584	371095	57 2
3 3	593067 593363	494 494	963811 963757	90	629255 629606	584 583	370745	56 2
5 6	593659	493	963704	90	629956	583	370394 370044	55 }
5 7	593955	493	963650	90	630306	583	369694	53
5 8	594251	493	963596	90	630656	583	369344	52 5
) 9	594547	492	963542	90	631005	582	368995	51 }
) 10	594842	492	963488	90	631355	582	368645	50 >
₹11	9.595137	491	9-963434	90	9-631704	582	10.368296	49 (
12	595432	491	963379	90	632053	581	367947	48 (
13	595727	491	963325	90	632401	581	367599	47 (
14	596021 596315	490 490	963271 963217	90 90	632750 633098	581 580	367250	46 \
5 16	596609	489	963163	90	633447	580	366902 366553	45 4
) 17	596903	489	963108	91	633795	580	366205	43 2
2 18	597196	489	963054	91	634143	579	365857	42 }
2 19	597490	488	962999	91	634490	579	365510	41 (
∤2 0	597783	4 88	962945	91	634838	579	365162	40 6
(21	9.598075	487	9-962890	91	9-635185	578	10.364815	39 (
(22	598368	487	962836	91	635532	578	364468	38 \$
23	598660	487	962781	91	635879	578	364121	37 5
25	598952 599244	486 486	962727 962672	91 91	636226 636572	577	363774 363428	36 5
26	599536	485	962617	91	636919	577 577	363081	35 {
27	599827	485	962562	91	637265	577 `	362735	33 (
₹28	600118	485	962508	91	637611	576	362389	32 (
(29	600409	484	962453	91	637956	576	362044	31 (
30	600700	484	962398	92	638302	576	361698	30 \
31	9.600990	484	9.962343	92	9.638647	575	10.361353	29 \$
32	601280	483	962288	92	638992	575	361008	28)
33	601570	483	962233	92	639337	575	360663	27
35	601860 602150	482 482	962178 962123	92 92	639682 640027	574 574	360318 359973	26 }
36	602439	482	962067	92	640371	574	359629	24
5 37	602728	481	962012	92	640716	573	359284	23 (
38	603017	481	961957	92	641060	573	358940	22 5
39	603305	481	961902	92	641404	573	358596	21 5
7 40	603594	480	961846	92	641747	572	358253	20 \$
241	9.603882	480	9.961791	92	9.642091	572	10.357909	19 >
42	604170	479	961735	92	642434	572	357566	18 /
7 44	604457 604745	479 479	961680 961624	92 93	642777 643120	572 571	357223 356880	17)
45	605032	478	961569	93	643463	571	356537	16 /
3 46	605319	478	961513	93	643806	571	356194	14
) 47	605606	478	961458	93	644148	570	355852	13)
) 4 8	605892	477	961402	93	644490	570	355510	12)
49	606179	477	931343	93	644832	570	355168	11)
250	606465	476	961290	93	645174	569	354826	10 \
₹ 51	9.606751	476	9-961235	93	9-645516	569	10.354484	9 (
52 53	607036	476	961179	93	645857	569	354143	8
≥ 53 ≥ 54	607322 607607	475 475	961123 961067	93 93	646199 646540	569 568	353801 353460	7 6
55	607892	474	961011	93	646881	568	353119	5
2 56	608177	474	960955	93	647222	568	352778	4 }
(57	608461	474	960899	93	647562	567	352438	3/
₹ 58	608745	473	960843	94	647903	567	352097	2)
59	609029	473	960786	94	648243	567	351757	1 (
3 60	609313	473	960730	94	648583	566	351417	-03
in- !	Comne	1	Sine	١	Cotang.		Tang.	M. S

66 Degrees.

M.	Sine	~~ β.~~	Cosine) D.	Tang.	~~~~	Cotang.	~~
0	9-609313	473	9-960730	94	9-648583	566	10-351417	60
1	609597	472	960674	94	648923	566	351077	59)
2 3	609880 610164	472 472	960618 960561	94	649263 649602	566 566	350737	58 5
4	610447	471	960505	94 94	649942	565	350398 350058	57
5	610729	471	960448	94	650281	565	349719	55 \
6	611012	470	960392	94	650620	565	349380	54 (
7	611294	470	960335	94	650959	564	349041	53 (
8 (611576	470	960279	94	651297	564	348703	52 (
9	611858	469	960222	94	651636	564	348364	51 \
10	612140	469	960165	94	651974	563	348026	50 \
11	9-612421	469	9-960109	95	9-652312	563	10.347688	49 >
12	612702	468	960052	95	652650	563	347350	48 >
13	612983	468	959995	95	652988	563	347012	47)
14	613264	467	959938	95	653326	562	346674	46)
15 16	613545 613825	467 467	959882 959825	95 95	653663 654000	562 562	346337 346000	45
17	614105	466	959768	95	654337	561	345663	43
iii	614385	466	959711	95	654674	561	345326	42 5
19	614665	466	959654	95	655011	561	344989	41 5
20	614944	465	959596	95	655348	561	344652	405
21	9-615223	465	9-959539	95	9-655684	560	10-344316	39 5
22	615502	465	959482	95	656020	560	343980	38 >
23	615781	464	959425	95	656356	560	343644	37)
24	616060	464	959368	95	656692	559	343308	36 >
25	616338	464	959310	96	657028	559	342972	35 >
26	616616	463	959253	96	657364	559	342636	34 >
27	616894	463	959195	96	657699	559	342301	33 >
28	617172 617450	462 462	959138 959081	96 96	658034 658369	558 558	341966	32 >
30	617727	462	959023	96	658704	558	341631 341296	36
31			0.000.00					1 (
32	9-618004 618281	461 461	9-958965 958908	96 96	9·659039 659373	558 557	10·340961 340627	29 }
33	618558	461	958850	96	659708	557	340292	27
34	618834	460	958792	96	660042	557	339958	26
35	619110	460	958734	96	660376	557	339624	25
₹ 36	619386	460	958677	96	660710	556	339290	24)
237	619662	459	958619	96	661043	556	338957	23)
₹ 38	619938	459	958561	96	661377	556	338623	222 >
39	620213	459	958503	97	661710	555	338290	21 2
40	620488	458	958445	97	662043	555	337957	20 }
41	9-620763	458	9-958387	97	9-662376	555	10.337624	19 (
42	621038	457	958329	97	662709	554	337291	18 (
43	621313 621587	457 457	958271 958213	97 97	663042 663375	554 554	336958 336625	17 /
44	621861	456	958213	97	663707	554 554	336293	15 <
46	622135	456	958096	97	664039	553	335961	14)
47	622409	456	958038	97	664371	553	335629	135
₹ 48	622682	455	957979	97	664703	553	335297	12 >
₹49	622956	455	957921	97	665035	553	334965	11)
₹ 50	623229	455	957863	97	665366	552	334634	10 >
51	9.623502	454	9-957804	97	9-665697	552	10-334303	9)
52	623774	454	957746	98	666029	552	333971	8)
53	624047	454	957687	98	666360	551	333640	7 2
54	624319	453	957628	98	666691	551	233309	6 }
55	624591	453	957570	98	667021	551	332979	5 }
56	624863	453 452	957511	98	667352	551	332648	3
57	625135 625406	452 452	957452 957393	98 98	667682 668013	550 550	332318 331987	2 }
59	625677	452	957335	98	668343	550 550	331657	1 13
ໄ ຄັນ	625948	451	957276	1 28	668672	550 550	331328	Ιōζ
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37 635834 439 955065 101 680768 540 319232 23 38 636097 438 955005 101 681092 540 318908 22 40 636623 438 954944 101 681416 539 318584 21 41 9636886 437 954823 101 681740 539 318260 20 42 637148 437 954762 101 682387 539 317937 19 43 637414 437 954701 101 682387 539 317930 17 43 637673 437 954040 101 682387 539 317930 17 45 637935 436 954579 101 683356 538 316644 15 46 638197 436 954518 102 684001 537 31599 13 47 638458 436					101		540		25
38 636097 438 955005 101 681092 540 318906 32 318906 32 318906 32 318906 32 318584 21 318906 32 318584 21 318584									
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43 637411 437 954701 101 6892710 538 317290 17 44 637673 437 954640 101 683033 538 316967 16 45 637935 436 954579 101 683365 538 316967 16 47 638458 436 954578 102 683679 538 316321 14 48 638720 435 954396 103 684324 537 3153676 12 49 638981 435 954274 102 684666 537 315354 11 50 639242 435 954274 102 684968 537 315032 10 51 97639503 434 9954213 102 685692 536 10-314710 9 52 639764 434 954192 102 685612 536 314388 6 53 640024 434									
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49 638981 435 954335 102 684646 537 315354 11 50 639242 435 954274 102 6846968 537 315032 10 51 9*639503 434 9*954213 102 9*685290 536 10*314710 9 52 639764 434 954152 102 685612 536 314388 8 53 640024 434 954090 102 685934 536 314066 7 54 640284 433 954029 102 686255 536 313423 5 55 640544 433 953008 102 66677 535 313423 5 56 640804 433 953908 102 667219 535 313(22 5 57 641064 432 953845 102 687219 535 312781 3 58 641324 432	47	638458		954457	102	684001		315999	13 }
50 639242 435 954274 102 684968 537 315032 10 51 9-639503 434 9954213 102 9-685290 536 10-314710 9 52 639764 434 954152 102 685612 536 314368 8 53 640024 434 954090 102 685934 536 314066 7 6 54 640284 433 954029 102 686577 535 313423 5 6 640644 433 953968 102 686577 535 313423 5 5 640644 433 953968 102 686577 535 313412 4 6 57 641064 432 953845 102 686598 533 313102 4 6 57 53 312781 3 312781 3 58 641324 432 953783 102 687219 535 312781				954396					
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55 640544 433 953968 102 696577 535 313492 5 56 640804 433 953906 102 696898 535 313192 4 57 641064 432 953845 102 687219 535 312781 3 58 641324 432 953783 102 687540 535 312460 2 59 641584 432 953722 103 687861 534 312139 1 60 641842 431 953660 103 688182 534 311818 0									
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			432						
Cosine Sine Cotang. Tang. M.	60	641842	431	953660	103	688182	534	311818	· 0 〈
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64 Degrees.

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0	J-641842	431	9-953660	103	9-688182	534	10-311818	60
1	642101	431	953599	103	688502	534	311498	59
2	642360 642618	421 430	953537 953475	103 103	688823 689143	534 533	311177 310857	58 57
4	642877	430	953413	103	689463	533	310537	56
5	643135	430	953352	103	689783	533	310217	55
6	643393	430	953290	103	690103	533	309897	54
7	643650	429	953928	103	690423	533	309577	53
8	643908	429	953166	103	690742	532	309258	52
9	644165	429	953104	103	691062	532	308938	51
10	644423	428	953042	103	691381	532	308619	50
11	9-644680	428	9-952980	104	9-691700	531	10-308300	49
12	644936	428	952918	104	692019	531	307981	48
13	645193	427	952855	104	692338	531	307662	47
14	645450	427	952793	104	692656	531	307344	46
15	645706	427 426	952731	104	692975	531 530	307025	45
16 17	645962 646218	426	952669 952606	104	693293 693612	530	306707 306388	44
18	646474	426	952544	104	693930	530	306070	42
19	646729	425	952481	104	694248	530	305752	41
25	646964	425	952419	104	694566	529	305434	40
21	9-647240	425	9-952356	104	9-694883	529	10-305117	39
22	647494	424	952294	104	695201	529	304799	38
23	647749	424	952231	104	695518	529	304482	37
24	648004	424	952168	105	695836	529	304164	36
25	648258	424	952106	105	696153	528	303847	35
26	648512	423	95:2043	105	696470	528	303530	34
27	648766	423	951980	105	696787	528	303213	33
28	649020	423	951917	105	697103	528	302897	32
29	649274	422	951854	105	697420	527	302580	31
30	649527	422	951791	105	697736	527	302264	30
31	9-649781	422	9-951728	105	9-696053	527	10-301947	29
32	650034	422	951665	105	698369	527	301631	28
33	650287	421	951662	105	698685	526	301315	27
34	650539	421	951539	105	699001	526	300999	26
35 36	650792	421 420	951476	105	699316 699632	526 526	300684 300368	25 24
30 37	651044 651297	420	951412 951349	105 106	699947	526	300053	23
38	651549	420	951286	106	706263	525	299737	22
33	651800	419	951222	106	700578	525	299422	21
40	652052	419	951159	106	700893	525	299107	20
41	9.652304	419	9-951096	106	9.701208	524	10-298792	19
12	652555	418	951032	106	701523	524	298477	18
43	652806	418	950968	106	701837	524	298163	17
44	653057	418	950905	106	702152	524	297848	16
45	653308	418	950841	106	702466	524	297534	15
46	653558	417	950778	106	702780	523	297220	14
47	653808	417	950714	106	703095	523	296905	13
48	654059	417	950650	106	703409	523	296591	12
49	654309	416	950586	106	703723	523	296277	111
50	654558	416	950522	107	704036	522	295964	10
51	654808	416	9-950458	107	9.704350	522	10-295650	9
52	655058	416	950394	107	704663	522	295337	8
53	655307	415	950330	107	704977	522	295023	7
54	655556	415	950266	107	705290	522	294710	6
55 56	655805	415 414	950202 950138	107	705603	521 521	294397 294084	5 4
57	656054 656302	414	950138	107	705916 706228	521 521	294064	3
58	656551	414	950014	107 107	706541	521	293772	2
59	656799	413	949945	107	706854	521	293146	lĩ
60	657047	413	949881	107	707166	520	292834	۱ô
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ò	9-657047	413	9-949881	107	9-707166	520	10-292834	60 2		
) i	657295	413	949816	107	707478	520	292522	59 ?		
2	657542	412	949752	107	707790	520	292210	58 (
3	657790	412	949688	108 108	708102	520	291898	57 (
₹ 4 5	658037 658284	412 412	949623 949558	108	708414 708726	519 519	291586 291274	56 55		
5 6	658531	411	949494	108	709037	519	290963	54 5		
5 7	658778	411	949429	108	709349	519	290651	53		
S å	659025	411	949364	108	709660	519	290340	52		
) ğ	659271	410	949300	108	709971	518	290029	51)		
) 10	659517	410	949235	108	710282	518	289718	50 >		
∂ 11	9-659763	410	9-949170	108	9-710593	518	10-289407	49 ₹		
(12	660009	409	949105	108	710904	518	289096	48 (
₹ 13	660255	409	949040	108	711215	518	288785	47 (
(14	660501	409	948975	108	711525	517	288475	46 (
₹ 15	660746	409	948910	108	711836	517	288164	45 \		
{ 16 17	660991 661236	408 408	948845 948780	108 109	712146 712456	517 517	287854 287544	44 4		
18	661481	408	948715	109	712766	516	287234	42		
2 19	661726	407	948650	109	713076	516	286924	1 41 2		
20	661970	407	948584	109	713386	516	286614	40 2		
21	9-662214	407	9-948519	109	9-713696	516	10-286304	39 (
22	662459	407	948454	109	714005	516	285995	38 ⟨		
₹23	662703	406	948388	109	714314	515	285686	37 (
(24	662946	406	948323	109	714624	515	285376	36 (
(25	663190	406	948257	109	714933	515	285067	35 〈		
(26	663433	405	948192	109	715242	515	284758	34 (
5 27	663677	405	948126	109	715551	514	284449	33 (
(28 (29	663920 664162	405 405	948060 947995	109 110	715860 716168	514 514	284140 283832	32 (
(30	664406	404	947999	110	716477	514	283523	36 2		
7										
31 32	9-664648 664891	404	9-947863 947797	110 110	9-716785 717093	514 513	10-283215 282907	29 5		
33	665133	404 403	947731	110	717401	513	282599	27 }		
34	665375	403	947665	110	717709	513	282291	26 (
35	665617	403	947600	110	718017	513	281983	25 (
36	665859	402	947533	110	718325	513	281675	24 (
37	666100	402	947467	110	718633	512	281367	23 \		
38	666342	402	947401	110	718940	512	281060	22 5		
39	666583	402	947335	110	719248	512	280752	21 5		
40	666824	401	947269	110	719555	512	280445	20 5		
₹ 41	9.667065	401	9-947203	110	8.719862	512	10-280138	19 >		
42	667305	401	847136	111	720169	511	279831	18 }		
43	667546	401	947070 947004	111 111	720476 720783	511 511	279524 279217	17 16		
44 45	667786 668027	400 400	947004	111	721089	511	278911	15 3		
46	668267	400	946871	111	721396	511	278604	13 3		
47	668506	399	946804	iii	721702	510	278298	1 13 5		
48	668746	399	946738	iii	722009	510	277991	12 5		
49	668986	399	946671	iii	722315	510	277685	lii s		
50	669225	399	946604	111	722621	510	277379	10 5		
(51	9-669464	398	9-946538	111	9-722927	510	10-277073	9 >		
(52	669703	398	946471	111	723232	509	276768	18)		
53	669942	398	946404	111	723538	509	276462	7 2		
54	670181	397	946337	111	723844	509	276156	6 (
55	670419	397	946270	112	724149	509	275851	5 2		
56	670658	397	946203	112	724454	509	275546	4 (
57 58	670896	397 396	946136 946069	112 112	724759 725065	508 508	275241 274935	3 2		
59	671134 671372	396	946009	112	725369	508	274935	1 1 5		
60	671609	396	945935	112	725674	508	274326	١å۶		
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62 Degrees.

(M.	Sine) D.	Cosine	~~~~	Tang.	~~~	Cotang.	~~
50	9-671609	396	9-945935	1 112	9-725674	508	10-274326	1 60
٤ĭ١	671847	395	945868	112	725979	508	274021	59
5 2	672084	395	945800	112	726284	507	273716	58 5
۶ã	672321	395	945733	112	726588	507	273412	57 5
) 4	672558	395	945666	112	726892	507	273108	56 5
5	672795	394	945598	113	727197	507	272803	55 5
S 6	673032	394	945531	113	727501	507	272499	54 5
7	673268	394	945464	113	727805	506	272195	53 5
8 (673505	394	945396	113	728109	506	271891	59
9	673741	393	945328	113	728412	506	271588	51 >
) 10	673977	393	945261	113	728716	506	271284	50 >
111	9-674213	393	9-945193	113	9-729020	506	10-270980	49 >
12	674448	392	945125	113	729323	505	270677	48 2
∤ 13 .	674684	392	945058	113	729626	505	270374	47 2
≥ 14	674919	392	944990	113	729929	505	270071	46 ?
15	675155	392	944922	113	730233	505	269767	45 (
16	675390	391	944854	113	730535	505	269465	44 (
17	675624	391	944786	113	730838	504	269162	43 (
18	675859	391	944718	113	731141	504	268859	42 (
2 19	676094	391	944650	113	731444	504	268556*	41 (
} 20	676328	390	944582	114	731746	504	268254	40 (
₹ 21	9-676562	390	9-944514	114	9-732048	504	10-267952	39 (
₹22	676796	390	941446	114	732351	503	267649	38 (
23	677030	390	944377	114	732653	503	267347	37 (
24	677264	389	944309	114	732955	503	267045	36 (
25	677498	389	944241	114	733257	503	266743	35 (
₹ 26	677731	389	944172	114	733558	503	266442	34 \$
27	677964	388	944104	114	733860	502	266140	33 5
∤ 28	678197	388	944036	114	734162	502	265838	32 5
29	678430	388 388	943967	114	734463	502	265537	31 5
30	678663		943899	114	734764	502	265236	30 %
ζ 31	9 678895	387	9-943830	114	9-735066	402	10-264934	29)
(32	679128	387	943761	114	735367	502	264633	28)
₹ 33	679360	387	943693	115	735668	501	264332	27
34	679592	387	943624	115	735969	501	264031	26 >
(35 (36	679824	386 386	943555	115	736269	501	263731	25 >
30	680056 680288	386	943486 943417	115	736570	501	263430 263129	24 }
38	680519	385	943417	115	736871 737171	501 500	262829	22 \
39	680750	385	943279	115 115	737471	500	262529	21 3
2 40	680982	385	943219	115	737771	500 500	262229	20 3
,								1 (
5 41	9-681213	385	9-943141	115	9-738071	500	10-261929	19 (
42	681443	384	943072	115	438371	500	261629	18 (
43	681674	384	943003	115	738671	499	261329 261029	17 }
44	681905 682135	384 384	942934 942864	115	738971 739271	409 499	260729	16 /
\ 46	682365	383	942795	115 116	739570	499	260430	135
₹6 47	682595	383	942795	116	739870	499	260130	13
₹48	682825	383	942656	116	740169	499	259831	125
149	683055	383	942587	116	740468	498	259532	1115
(50 €	683284	382	942517	116	740767	498	259233	165
51	9-683514	382	9-942448		9-741066	498	10-258934	9
52	683743	382	942378	116	741365	498 498	258635	
53	683972	382	942378	116	741363	498 498	258336	8 {
54	684201	381	942239	116 116	741004	496	258038	68
55	684430	381	942239		741902	497	257739	5
ر ا	684658	381	942109	116 116	742251	497	257441	4
57	684887	380	942029	116	742858	497	257142	3 (
58	685115	380	941959	116	743156	497	256844	💈 🗎
(59	685343	380	941889	117	743454	497	256546	lî≀
60	685571	380	941819	1 117	743752	496	256248	1 å }
(
•	Cosine		Bine	1	Cotang.	1 _	Tang.	M.)

61 Degrees.

<u>۲</u>	8ine	~~~~	Cosine	~~~~	Tang.	~~~~	Cotang.	~~
50	9-685571	380	9-941819	117	9-743759	1 496	10-256248	60 >
ì	685799	379	941749	117	744050	496	255950	59)
2 (686027	379	941679	117	744348	496	255652	58 2
) 3	686254	379	941609	117	744645	496	255355	57 2
7 4	686482	379	941539	117	744943	496	255057	56 }
2 5	686709	378	941469	117	745240	496	254760	55 (
2 6	686936	378	941398	117	745538	495	254462	54 (
7	687163	378	941328	117	745835	495	254165	53 }
8 }	687389	378 377	941258 941187	117	746132 746429	495 495	253868 253571	51
3 10	687616 687843	377	941117	117	746726	495	253274	50 5
(
111	9-688069	377	9-941046	118	9-747023	494 494	10-252977 252681	49 / 48 2
\ \frac{12}{13}	688295 688521	377	940975 940905	118 118	747319 747616	494	252384	47 2
114	688747	376 376	940834	118	747913	494	252087	46 2
15	688972	376	940763	118	748209	494	251791	45 2
16	689198	376	940693	118	748505	493	251495	44 ≥
7 17	689423	375	940622	118	748801	493	251199	43 2
) iš	689648	375	940551	118	749097	493	250903	42 2
19	689873	375	940480	118	749393	493	250607	41 (
20	680098	375	940409	118	749689	493	250311	40 (
∂21	9-690323	374	9-940338	118	9-749985	493	10-250015	39 (
7 22	690548	374	940267	118	750281	492	249719	38 (
₹23	690779	374	940196	118	750576	492	249424	37 (
24	690996	374	940125	119	750872	492	249128	36 ⟨
₹ 25	691220	373	940054	119	751167	492	248833	35 \
₹26	691444	373	939982	119	751462	492	248538	34 \$
27	691668	373	939911	119	751757	492	248243	33 \$
₹28	691892	373	939840	119	752052	491	247948	32 5
₹29	692115	372	939768	119	752347	491	247653	31 5
}30	692339	372	939697	119	752642	491	247358	30 \$
31	9-692562	372	9-939625	119	9-752937	491	10:247063	29 }
32	692785	371	939554	119	753231	. 491	246769	28
33	693008	371	939482	119	753526 753820	491	246474	27 }
35	693231 693453	371 371	939410 939339	119 119	754115	490 490	246180 245885	25
(36	693676	370	939267	120	754409	490	245591	24 5
₹37	693898	370	939195	120	754703	490	245297	23 5
₹38	694120	370	939123	120	754997	490	245003	22 (
₹39	694342	370	939052	120	755291	490	244709	21 5
₹40	694564	369	938980	120	755585	489	244415	20 \$
₹41	9-694786	369	9-938908	120	9-755878	489	10-244122	19
42	695007	369	938836	120	756172	489	243828	18 >
43	695229	369	938763	120	756465	489	243535	17 >
(44	695450	368	938691	120	756759	489	243241	16 2
45	695671	368	938619	1:20	757052	489	242948	15 (
5 46	695892	368	938547	120	757345	488	242655	14 (
547	696113	368	938475	120	757638	488	242362	13 }
§ 48	696334	367	938402	121	757931	488	242069	12 \
5 49	696554	367	938330	121	758224	488 488	241776	11 (
50	696775	367	938258	121	758517		241483	10 }
51	9-696995	367	9-938185	121	9-758810	488	10-241190	95
52	697215	366	938113	121	759102	487	240698	85
53	697435	366	938040	121	759395	487	240605	75
54	697654	366	937967	121 121	759687 759979	487 487	240313 240021	65
) 56	697874 698094	366 365	937895 937822	121	760272	487	239728	5 %
57	698313	365	937749	121	760564	487	239436	3 /
58	698532	365	937676	121	760856	486	239144	4 { 3 } 2 {
(59	698751	365	937604	121	761148	486	238852	lĩ≀
\$ 60	698970	364	937531	121	761439	486	238561	Ιōζ
>	Cosine)	Sine	ī	Cotang.	i .	Tang.	M.
1			L ~ ~ ~ ~	!		مممد'	لمقتتمما	

60 Degrees.

\ <u>M</u> .	Sine	~~~	Cosine		Tang.	~~~	Cotang.	~~
10	9-690970	364	9-937531	121	9-761439	486	10-238561	60
) 1	699189	364	937458	122	761731	486	238269	59
≥ 2	699407	364	937385	122	762023	486	237977	58
3	699626 699644	364 363	937312 937238	122 122	762314 762606	486 485	237686 237394	57 56
3 4	700062	363	937165	122	762897	485	237103	55
5 6	700280	363	937092	122	763188	485	236812	54
) 7	700498	363	937019	122	763479	485	236521	53 5
) š	700716	363	936946	122	763770	485	236230	32
) 9	700933	362	936879	122	764061	485	235939	51 \$
2 10	70115 1	362	936799	122	764352	484	235648	50
(11	9.701368	362	9-936725	122	9-764643	484	10-235357	49 2
(12	701585	362	936652	123	764933	484	235067	48
(13	701802	361 361	936578 936505	123 123	765224 765514	484 484	234776	47
\$ 14	702019 702236	361	936431	123	765805	484	234486 234195	46
(15 (16	702452	361	936357	123	766095	484	233905	44
₹ 17	702669	360	936284	123	766385	483	233615	43
₹ îŝ	702885	360	936210	123	766675	483	233325	42 (
(19	703101	360	936136	123	766965	483	233035	41
ζ20	703317	360	936062	123	767255	483	232745	40 (
\$ 21	9-703533	359	9-935988	123	9-767545	483	10-232455	39 (
5 22	703749	359	935914	123	767834	483	232166	38 (
5 23	703964	359	935840	123	768124	482	231876	37
24	704179	359 359	935766 935632	124 124	768413 768703	482 482	231587 231297	36 (
25 26	704395 704610	358	935618	124	768992	482	231008	34
\$ 27	704825	358	935543	124	769281	482	230719	33 8
\ 28	705040	358	935469	124	769570	482	230430	32
\$ 29	705254	358	935395	124	769860	481	230140	31
5 30	705469	357	935320	124	770148	481	229852	30 9
31	9.705683	357	9.935246	124	9-770437	481	10-229563	29
32	705898	357	935171	124	770726	481	229274	28
23	706112	357	935097	124	771015	481	228985	27
₹ 34	706326	356	935022	124	771303	481	228697	26
35	706539 706753	356 356	934948 934873	124 124	771592 771880	481 480	228408 228120	24
37	706967	356	934798	125	772168	480	227832	23
38	707180	355	934723	125	772457	480	227543	222
39	707393	355	934649	125	772745	480	227255	21
240	707606	355	934574	125	773033	480	226967	20)
₹41	9.707819	355	9-934499	125	9 773321	480	10.226679	19 (
42	708032	354	934424	125	773608	479	226392	18 (
43	708245	354	934349	125	773896	479	226104	17 (
5 44	708458	354 354	934274	125 125	774184 774471	479	225816 225529	16 d
45	708670 708882	354	934199 934123	125	774759	479 479	2255241	14
47	709094	353	934048	125	775046	479	224954	13
₹ 48	709306	353	933973	125	775333	479	224667	12 2
49	709518	353	933898	126	775621	478	224379	11 ?
\$ 50	709730	353	933822	126	775908	478	224092	10 \
51	9-709941	352	9-933747	126	9.776195	478	10:223805	9 (
52	710153	352	933671	126	776482	478	223518	8 9
53	710364	352	933596	126	776769	478	223231	75
54	710575	352 351	933520	126	777055 777342	478	222945 222658	6 5
56	710786 710997	351 351	933445 933369	126 126	777628	478 477	222372	4 2
57	711208	351	933293	126	777915	477	222065	3 (
58	711419	351	933217	126	778201	477	221799	2.
59	711629	350	933141	126	778487	477	221512	l i (
60	711839	350	933066	126	778774	477	221226	0 9
?	Cosme	1	Sine	1	Cotang.		Tang.	M.

<u>ښ</u>	Sine		Cosine	D. 1	Ti ng.	~~~	Cotang.	~~		
50	9-711839	350	9-933066	126	9-778774	477	10-221226	60 2		
Ţ	712050 712260	350 350	932990 932914	127 127	779060 779346	477 476	220940 220654	59 53		
2 3	712469	349	932838	127	779632	476	220368	57		
5 4	712679	349	932762	127	779918	476	220082	53		
5	712889	349	932685	127	780203	476	219797	55 >		
6	713098	349	932609	127	780489	476	219511	54 2		
) ž	713309	349	932533	127	780775	476	219225	53 è		
) 8	713517	348	932457	127	781060	476	218940	52 (
) 9	713726	343	932380	127	781346	475	218654	51 (
10	713935	348	932304	127	781631	475	218369	50 ₹		
11	9-714144	348	9-932228	127	9-781916	475	10-218084	49 (
(12	714352	347	932151	127	782201	475	217799	48 (
(13	714561	347	932075	128	782486	475	217514	47 (
(14	714769	347	931998	128	782771	475 475	217229	46 \$		
(15	714978 715186	347 347	931921	128 128	783056 783341	475	216944 216659	45 {		
\ 16 17	715394	346	931845 931768	128	783626	474	216374	43		
18	715602	346	931691	128	783910	474	216090	42 (
19	715809	346	931614	128	784195	474	215805	41 2		
200	716017	346	931537	128	784479	474	215521	40 ₹		
21	9-716224	345	9-931460	128	9-784764	474	10-215236	39 \$		
22	716432	345	931383	128	785048	474	214952	38		
23	716639	345	931306	128	785332	473	214668	37		
₹ 24 i	716846	345	931229	129	785616	473	214384	36 1		
25	717053	345	931152	129	785900	473	214100	35 (
(26	717259	344	931075	129	786184	473	213816	34 5		
⟨27	717466	344	930998	129	786468	473	213532	33 5		
∢28	717673	344	930921	129	786752	473	213248	32 5		
⟨29	717879	344	930843	129	787036	473	212964	31 5		
}30	718085	343	930766	129	787319	472	212681	30 }		
31	9.718291	343	9-930688	129	9-787603	472	10-212397	29 >		
32	718497	343	930611	129	787886	472	212114	28 (
33	718703	343	930533	129	788170	472 472	211830	27 }		
34	718909 719114	343 342	930456 930378	129 129	788453 788736	472	211547 211264	25		
36	719320	342	930300	130	789019	472	210981	24 5		
37	719525	342	930223	130	789302	471	210698	23		
⟨38	719730	342	930145	130	789585	471	210415	222 5		
(39	719935	341	930067	130	789868	471	210132	21 5		
(40	720140	341	929989	130	790151	471	209849	20)		
5 41	9-720345	341	9-929911	130	9-790433	471	10.209567	119		
5 42	720549	341	929833	130	790716	471	209284	iš }		
5 43	720754	340	929755	130	790999	471	209001	17 2		
44	720958	340	929677	130	791281	471	208719	16 (
45	721162	340	929599	130	791563	470	208437	15 2		
46	721366	340	929521	130	791846	470	208154	14 \		
47	721570	340	929442	130	792128	470	207872	13 (
48	721774	339	929364	131	792410	470	207590	12 }		
49 50	721978	339 339	929286	131	792692 792974	470 470	207308 207026	11 }		
•	722181		929207	131		1	1			
251	9·722385	339	9-929129	131	9-793256	470	10-206744	83		
≥ 52 53	722588	339	929050	131	793538	469	206462	8 7 8		
54	722791 722994	338 338	928972 928893	131 131	793819 794101	469 469	206181 205899	68		
55	723197	338	928815	131	794383	469	205699	5 }		
56	723400	338	928736	131	794664	469	205336	4-₹		
57	723603	337	928657	131	794945	469	205055	3 2		
58	723805	337	928578	131	795227	469	204773	1 2 2		
59	724007	337	928499	131	795508	468	204492	11		
60	794210	337	928420	131	795789	468	204211	ιōζ		
> —	Cosine	1	Sine		Cotang.	1	Tang.	TML		
~~	~~~~~	~~~	$\sim\sim\sim$	~~~	~~~~	~~~	~~~~~	كمتشهد		
58 Degrees.										

۲ ۳ ۰	Sine	~~~~	Conine	~~~~	Tang.		Cotang.	~~
50	9.724210	337	9.928420	1 132	9-795789	468	10-204211	1 60 2
١	724412	337	928342	132	796070	468	203930	59
〉 2	724614	336	928263	132	796351	468	203649	58 }
) 3	724816	336	928183	132	796632	468	203368	57 ≥
) 4	725017	336	928104	132	796913	468	203087	56 €
⟩ 5	725219	336	928025	132	797194	468	202806	55 2
) <u>6</u>	725420	335	927946	132	797475	468	202525	54 (
7	725622	335	927867	132	797755	468	202245	53 (
8 (725823	335	927787	132	798036	467	201964	52 (
2.9	726024	335	927708	132	798316	467	201684	51 (
) 10	726225	335	927629	132	798596	467	201404	50 (
∤ 11	9.726426	334	9-927549	132	9-798877	467	10-201123	49 5
12	726626	334	927470	133	799157	467	200843	48 5
2 13	726827	334	927390	133	799437	467	200563	47 5
14	727027	334	927310	133	799717	467	200283	46 5
2 15	727228	334	927231	133	799997	466	200003	45 }
\ 16	727428	333	927151	133	800277	466	199723	44 5
\ <u>17</u>	727628	333	927071	133	800557	466	199443	43 >
) 18) 19	727828 728027	333 333	926991	133	800836	466	199164	42 }
20	728227	333	926911 926831	133 133	801116	466 466	198884	41 >
(801396		198604	40 }
\ 21 92	9.728427	332	9-926751	133	9-801675	466	10-198325	39 (
23	728626	332	926671	133	801955	466	198045	38 (
24	728825	332	926591	133	802234	465	197766	37 (
25	729024 729223	332 331	926511	134	802513	465	197487	36 (
26	729422	331	926431 926351	134 134	802792	465 465	197208	35 (
27	729621	331	926270	134	803072 803351	465	196928	34 /
28	729820	331	926190	134	803630	465	196649 196370	32
29	730018	330	926110	134	803908	465	196092	31 /
30	730216	330	926029	134	804187	465	195813	30 5
31	9 730415	330	1				1	I)
32	730613	330	9-925949 925868	134 134	9.804466	464	10-195534	29 5
33	730811	330	925788	134	804745 805023	464 464	195255	28 {
34	731009	329	925707	134	805302	464	194977 194698	26 3
35	731206	329	925626	134	805580	464	194420	25 \
236	731404	329	925545	135	805859	464	194141	24 ⟨
₹37	731602	329	925465	135	806137	464	193863	23 (
(38	731799	329	925384	135	806415	463	193585	22 (
/39	731996	328	925303	135	806693	463	193307	21 (
⟨40	732193	328	925222	135	806971	463	193029	20 (
⟨41	9 732390	328	9-925141	135	9-807249	463	10-192751	19 \$
42	732587	328	925060	135	807527	463	192473	1 18 5
43	732784	328	924979	135	807805	463	192195	175
§ 44	732980	327	924897	135	808083	463	191917	16 }
45	733177	327	924816	135	808361	463	191639	15)
5 46	733373	327	924735	136	808638	462	191362	14 >
5 47	733569	327	924654	136	808916	462	191084	13 >
48	733765	327	924572	136	809193	462	190807	12 2
49	733961	326	924491	136	809471	462	190529	11 5
50	734157	326	924409	136	809748	462	190252	10 \$
51	9 734353	326	9-924328	136	9-810025	462	10-189975	9 (
52	734549	326	924246	136	810302	462	189698	8 (
53	734744	325	924164	136	810580	462	189420	174
254	734939	325	924083	136	810857	462	189143	6 (
55	735135	325	924001	136	811134	461	188866	5 5
56 57	735330	325	923919	136	811410	461	188590	45
58	735525	325 324	923837	136	811687	461	188313	35
59	735719 735914	324	923755 923673	137 137	811964	461	188036	25
60	736109	324	923591	137	812241 812517	461 461	187759 187483	1 {
\				. 101				
)	Cosine	L	Sine	1 1	Cotang.		Tang.	ML)

M .	Sine	~~~~ ; D.	·		Tang.	~~~	Cotang.	$\widetilde{}$
0	9-736109	324	9-923591	137	9-812517	461	10-187482	60
1 2	736303 736498	324 324	923509 923427	137	812794 813070	461 461	187206 186930	59 58
3	736692	323	923345	137	813347	460	186653	57
4	736886	323	923263	137	813623	460	186377	56
5	737080	323	923181	137	813899	460	186101	55
6	737274	323	923098	137	814175	460	185825	54
7	737467	323	923016	137	814452	460	185548	53
8	737661	322	922933	137	814728	460	185272	52
9 10	737855 738048	322 322	922851 922768	137 138	815004 815279	460 460	184996	51
			1				184721	50
11	9.738241	322 322	9-922686	138 138	9-815555	459	10.184445	49
12 13	738434 738627	322	922603 922520	138	815831 816107	459 459	184169 183893	48
14	738820	321	922438	138	816382	459	183618	46
15	739013	321	922355	138	816658	459	183342	45
16	739206	321	922272	138	816933	459	183067	44
17	739398	321	922189	138	817209	459	182791	43
18	739590	320	922106	138	817484	459	182516	42
19	739783	320	922023	138	817759	459	182241	41
20	739975	320	921940	138	818035	458	181965	40
21	9-740167	320	9.921857	139	9-818310	458	10-181690	39
22	740359	320	921774	139	818585	458	181415	38
23	740550	319	921691	139	818860	458	181140	37
24	740742	319	921607	139	819135	458	180865	36
25	740934	319	921524	139	819410	458	180590	35
26	741125	319	921441	139	819684	458 458	180316	34
27 28	741316 741508	319 318	921357 921274	139 139	819959 820234	458 458	180041 179766	33
29	741699	318	921190	139	820508	457	179492	31
30	741889	318	921107	139	820783	457	179217	30
31	9-742080	318	9-921023	139	9-821057	457	10-178943	29
32	742271	318	920939	140	821332	457	178668	28
33	742462	317	920856	140	821606	457	178394	27
34	742652	317	920772	140	821880	457	178120	26
35	742842	317	920688	140	822154	457	177846	25
36	743033	317	920604	140	822429	457	177571	24
37	743223	317	920520	140	822703	457	177297	23
38	743413	316	920436	140	822977	456	177023	22
39	743602 743792	316 316	920352	140	823250 823524	456 456	176750	21
40	1		920268.	140	0.000.00		176476	20
41	9-743982	316	9-920184	140	9-823798	456	10.176202	19
42	744171	316	920099	140	824072	456	175998	18
43	744361 744550	315 315	920015 919931	140 141	824345 824619	456 456	175655 175381	17 16
45	744530	315	919933	141	824893	456	175107	15
46	744928	315	919762	141	825166	456	174834	13
47	745117	315	919677	141	825439	455	174561	13
48	745306	314	919593	141	825713	455	174287	12
49	745494	314	919508	141	825986	455	174014	11
50	745683	314	919424	141	826259	455	173741	10
51	9-745871	314	9-919339	141	9.826532	455	10-173468	9
52	746059	314	919254	141	826805	455	173195	8
53	746248	313	919169	141	827078	455	172922	7
54	746436	313	919085	141	827351	455	172649	6
55	746624	313	919000	141	827624	455	172376	5
56	746812	313	918915	142	827897	454	172103	4
57	746999	313	918830	142	828170	454	171830	3
58	747187	312	918745	142	828442	454	171558	2
59 60	747374 747562	312 312	918659 918574	142 142	828715 828987	454 454	171285 171013	1 0
w	141002	. 212	910014	142	0%0901	. 202	111019	U

56 Degrees.

∫` M .	Sine	~~~~	Cosine	~~~~	Tang.	~~~	Cotang.	 -	
0	9-747562	312	9-918574	142	9-828987	454	10-171013	60 (
) 1	747749	312	918489	142	829260	454	170740	59 (
2	747936	312	918404	142	829532	454	170468	58 (
3 4	748123	311	918318	142	829805	454	170195	57	
5	748310 748497	311	918233	142	830077	454 453	169923 169651	56 (55 (
5 6	748683	311 311	918147 9180 62	142 142	830349 830621	453	169379	54 2	
5 7	748870	311	917976	143	830693	453	169107	53 2	
S 8	749056	310	917891	143	831165	453	168835	522	
9	749243	310	917805	143	831437	453	168563	51 (
\ 10	749429	310	917719	143	831709	453	168291	50	
} ∙11 ∫	9-749615	310	9-917634	143	9-831981	453	10-168019	49 5	
12	749801	310	917548	143	832253	453	167747	48	
13	749987	309	917462	143	832525	453 453	167475 167204	47	
15	750172 750358	309 309	917376 917290	143 143	832796 833068	452	166932	45 \	
16	750543	309	917290	143	833339	452	166661	44 \	
17	750729	309	917118	144	833611	452	166389	43 5	
7 18	750914	308	917032	144	833882	452	166118	42 5	
2 19	751099	308	916946	144	834154	452	165846	41 5	
20	751284	308	916859	144	834425	452	165575	40 5	
(21	9.751469	308	9-916773	144	9.834696	452	10-165304	39 (
222	751654	308	916687	144	834967 835238	452	165033	38 (
24	751839	308	916600	144	835509	452 452	164762 164491	37 (
25	752023 752208	307	916514 916427	144 144	835780	451	164220	36 }	
26	752392	307	916341	144	836051	451	163949	34	
27	752576	307	916254	144	836322	451	163678	33	
28	752760	307	916167	145	836593	451	163407	32	
29	752944	306	916081	145	836864	451	163136	31 >	
₹ 30	753128	306	915994	145	837134	451	162866	30 }	
31	9-753312	306	9-915907	145	9.837405	451	10.162595	29 (
322	753495	306	915820	145	837675	451	162325	28 (
(33 (34	753679	306	915733	145	837946	451	162054	27 (
35	753862 754046	305 305	915646 915559	145 145	838216 838487	451	161784 161513	26 (
₹36	754046	305	915559	145	838757	450 450	161243	25 24	
₹ 37	754412	305	915385	145	839027	450	160973	23	
₹ 38	754595	305	915297	145	839297	450	160703	22	
39	754778	304	915210	145	839568	450	·160432	21 2	
40	754960	304	915123	146	839838	450	160162	20 (
5 41	9.755143	304	9-915035	146	9-840108	450	10 159892	19 (
42	755326	304	914948	146	840378	450	159622	18 (
43	755508	304	914860	146	840647	450	159353	175	
45	755690	304	914773	146 146	840917 841187	449	159083	16 5	
46	755872 756054	303	914685 914598	146	841457	449 449	158813 158543	15 {	
47	756236	303	914510	146	841726	449	158274	13 (
48	756418	303	914422	146	841996	449	158004	122	
49	756600	303	914334	146	842266	449	157734	117	
50	756782	302	914246	147	842535	449	157465	10 3	
51	9.756963	302	9-914158	147	9-842805	449	10-157195	9.5	
52	757144	302	914070	147	843074	449	156926	85	
∑ 53	757326	302	913982	147	843343	449	156657	1 75	
54	757507	302	913894	147	843612	449	156388	6 6	
56	757688 757869	301 301	913806 913718	147 147	843882 844151	448 448	156118 155849	5 }	
57	758050	301	913630	147	844420	448	155580	3	
58 I	758230	301	913541	147	844689	448	155311	2 (
59	758411	301	913453	147	844958	448	155042	lis	
60	758591	301	913365	147	845227	448	154773	١ō٤	
√	! Cosine Sine Cotang. Tang. M.								

55 Degrees.

SM.	Sine	~~ <u>D</u> .~	Coeine	~~~	Tang.	~~~	Cotang.	~~	3
0	9-758591	301	9-913365	147	9.845227	1 448	10-154773	60	5
λi	758772	300	913276	147	845496	448	154504	59	5
2 3	758952	300	913187	148	845764	448	154236	58	5
	759132	300	913099	148	846033	448	153967	57	>
} 4	759312	300	913010	148	846302	448	153698	56)
5	759492	300	912922	148	846570	447	153430	55	١.
6	759672	299	912833	148	846839	447	153161	54)
7	759852	299	912744	148	847107	447	152893	53)
8	760031	299	912655	148	847376	447	152624	52)
9.5	760211	299	912566	148	877644	447	152356	51	2
\ 10	760390	299	912477	148	847913	447	152087	50	2
(11	9-760569	298	9-912388	148	9.848181	447	10-151819	49	ł
(12	760748	298	912299	149	848449	447	151551	48	l
₹ 13	760927	298	912210	149	848717	447	151283	47	Ł
(14	761106	298	912121	149	848966	447	151014	46	(
(15	761285	298	912031	149	849254	447	150746	45	(
∤ 16 , 17	761464	298	911942	149	849522	447	150478	44	⟨
18	761642	297	911853	149	849790	446	150210	43	(
19	761821	297	911763	149	850058	.446	149942	42	< −
20	761999	297	911674	149	850325	446	149675	41	< −
```	762177	297	911584	149	850593	446	149407	40	ζ.
\$ 21	9-762356	297	9-911495	149	9-850861	446 `	10-149139	39	ζ.
922	762534	296	911405	149	851129	446	148871	38	ζ.
<b>23</b>	762712	296	911315	150	851396	446	148604	37	١.
\$ 24 ·	762889	296	911226	150	851664	446	148336	36	١.
(25 ) (26 )	763067	296	911136	150	851931	446	148069	35	ζ.
27	763245	296	911046	150	852199	446	147801	34	ζ
28	763422 763600	296	910956	150	852466	446	147534	33	5
(29	763777	295 295	910866 910776	150	852733	445	147267	32	5
(360 ∣	763954	295	910686	150	853001	445	146999	31	5
,		-		150	853268	445	146732	30	5
31	9-764131	295	9-910596	150	9-853535	445	10-146465	29	١.
33	764308	295	910506	150	853802	445	146198	28	)
33	764485 764662	204	910415	150	854069	445	145931	27	١.
35	764838	294 294	910325 910235	151	854336	445	145664	26	>
36	765015	294	910233	151 151	854603 854870	445	145397	25	)
37	765191	294	910054	151	855137	445 445	145130 144863	24	)
38	765367	294	909963	151	855404	445	144596	22	`
39	765544	293	909873	151	855671	444	144329	21	)
40	765720	293	909782	151	855938	444	144062	20	`
41	9.765896	293	9-909691	151	9-856204	444			ì
42	766072	293	909601	151	856471		10-143796	19	l
43	766247	293	909510	151	856737	444	143529 143263	18	1
44	766423	293	909419	151	857004	444	142996	17	′
45	766598	292	909328	152	857270	444	142730		)
46	766774	292	909237	152	857537	444	142463	14	(
47	766949	292	909146	152	857803	444	142197	13	(
48	767124	292	909055	152	858069	444	141931	12	ζ.
49	767300	292	908964	152	858336	444	141664	iĩ	ζ.
<b>∑</b> 50	767475	291	908873	152	858602	443	141398	10	(
₹ 51	9-767649	291	9-908781	152	9-858868	443	10-141172	9	١
52	767824	291	908690	152	859134	443	140866	8	5
₹ 53	767999	291	908599	152	859400	443	140600	7	5
₹ 54	768173	291	908507	152	859666	443	140334	6	5
₹ 55	768348	290	908416	153	859932	443	140068	5	5
₹ 56	768522	290	908324	153	860198	443	139802	4	5
₹ 57	768697	290	908233	153	860464	443	139536	3	)
⟨ 58	768871	200	908141	153	860730	443	139270	2	)
₹ 59	769045	290	908049	153	860995	443	139005	1	)
<u>ς 60</u>	769219	290	907958	153	861261	443	138739	l ō	٠,
5	l Cosine	l	Sine	i	Cotang.	1	Tang.	M.	)
~~	~~~~	مممذ		<u></u>		!		'	٠.

54 Degrees.

۲ M.	Sine	~~~~	Coeine	~~~	Tang.	~~~	Cotang.	~~
0	9.769219	290	9-907958	153	9-861261	443	10-138739	160 (
( 1	769393	289	907866	153	861527	443	138473	59 (
2 3	769566 769740	289 289	907774	153 153	861792 862058	442 442	138208 137942	58 {
} 4	769913	289	907590	153	862323	442	137677	56
1 5	770087	289	907498	153	862589	442	137411	55 }
( 6	770260	288	907406	153	862854	442	137146	54 (
7	770433	288 288	907314	154	863119	442	136881	53 (
8 9	770606 770779	288	907222 907129	154 154	863385 863650	442 442	136615 136350	52 ( 51 (
10	770952	288	907037	154	863915	442	136085	50 }
11	9-771125	288	9-906945	154	9-864180	442	10-135820	49 (
12	771298	287	906852	154	864445	442	135555	48 (
13	771470	287	906760	154	864710	442	135290	47 ₹
14	771643	287	906667	154	864975	441	135025	46 <
15	771815	287	906575	154	865240	441	134760	45 5
16 17	771987 772159	287 287	906482 906389	154 155	865505 865770	441 441	134495 134230	44 {
18	772331	286	906296	155	866035	441	133965	42
19	772503	286	906204	155	866300	441	133700	111
20	772675	286	906111	155	866564	441	133436	40 (
21	9-772847	286	9-906018	155	9.866829	441	10-133171	39 (
22	773018	286	905925	155	867094	441	132906	38 \
23	773190	286	905832	155	967358	441	132642	37
24	773361 773533	285 285	905739 905645	155 155	867623 867887	441 441	132377 132113	36 X
26	773704	285	905552	155	868152	440	131848	33 >
27	773875	285	905459	155	868416	440	131584	333 ₹
28	774046	285	905366	156	868680	440	131320	32 (
29	774217	285	905272	156	868945	440	131055	31 (
30	774388	284	905179	156	869209	440	130791	30 {
31	9-774558	284	9-905085	156	9-860473	440	10-130527	29 }
32 33	774729 774899	284 284	904992 904898	156 156	869737 870001	440 440	130263 129999	28 \
33	775070	284	904804	156	870265	440	129735	26
35	775240	284	904711	156	870529	440	129471	25
36	775410	283	904617	156	870793	440	129207	24 5
37	775580	283	904523	156	871057	440	128943	23 5
38	775750	283	904429	157	871321	440	128679	22 5
39 40	775920 776090	283 283	904335 904241	157 157	871585 871849	440 439	128415 128151	21 8
41	9-776250	283	9-904147	157	9-872112	439	10-127888	19
42	776429	282	904053	157	872376	439	127624	18 3
43	776598	282	903959	157	872640	439	127360	175
44	776768	282	903864	157	872903	439	127097	16 >
45	776937	282	903770	157	873167	439	126833	15 >
46	777106	282	903676	157	873430	439	126570	14)
47	777275 777444	281 281	903581 903487	157 157	873694 873957	439 439	126306 126043	13 }
49	777613	281	903392	158	874220	439	125780	lii s
50	777781	281	903298	158	874484	439	125516	iō S
51	9.777950	281	9-903203	158	9-874747	439	10-125253	9)
52	778119	281	903108	158	875010	439	124990	8/
53	778287	280	903014	158	875273	438	124727	7)
54	778455	280	902919	158	875536	438	124464	6 5
56	778624 778792	280 280	902824 902729	158 158	875800 876063	438 438	124200 123937	5 2
57	778960	280 280	902729	158	876326	438	123674	3 3
58	779128	280	902539	159	876589	438	123411	2 }
59	779295	279	902444	159	876851	438	123149	1 2
60	779463	279	902349	159	877114	438	122886	<u>' 0 }</u>
لحا	Cosine	~~~	Sine	1	Cotang.	~~~	Tang.	<u></u>

53 Degrees.

				INGEN	(0.	2081000	,	1.0
~~~	No Sine	~~~~	Cosine	~~~~	Tang.		Cotang.	~~
10	9-779463	1 279	9-902349	159	9-877114	1 438	10-122886	1 60 2
١ĭ	779631	279	902253	159	877377	438	122623	59 }
\	779798	279	902158	159	877640	438	122360	58
2 3	779966	279	902063	159	877903	438	122097	57
5 4	780133	279	901967	159	878165	438	121835	56
5	780300	278	901872	159	878428	438	121572	55
5 6	780467	278	901~76	159	878691	438	121309	54 5
5 7	780634	278	901681	159	878953	437	121047	53 5
S á	780801	278	901585	159	879216	437	120784	52
9	780968	278	901490	159	879478	437	120522	51
10	781134	278	901394	160	879741	437	120259	50
(	1			1				1 /
(11	9-781301	277	9-901298	160	9-880003	437	10-119997	49 \
12	781468	277	901202	160	880265	437	119735	48 \
( 13	781634	277	901106	160	880528	437	119472	47 }
( 14	781800	277	901010	160	880790	437	119210	46 }
( 15	781966	277	900914	160	881052	437	118948	45.
( 16	782132	277	900818	160	881314	437	118686	44
( 17	782298	276	900722	160	881576	437	118424	43
( 18	782464	276	900626	160	881839	437	118161	42 >
( 19	782630	276	900529	160	682101	437	117899	41 >
20	782796	276	900433	161	882363	436	117637	40 \
(21	9-782961	276	9-900337	161	9.882625	436	10-117375	39 )
22	783127	276	900240	161	882887	436	117113	38)
( 23	783292	275	900144	161	883148	436	116852	37 )
24	783458	275	900047	161	883410	436	116590	36 >
<b>25</b>	783623	275	899951	16 <b>r</b>	883672	436	116328	35 >
26	783788	275	899854	161	883934	436	116066	34
<b>₹ 27</b>	783953	275	899757	161	884196	436	115804	33 5
7 28	784118	275	899660	161	884457	436	115543	32 5
29	784282	274	899564	161	884719	436	115281	31
30	784447	274	899467	162	884980	436	115020	30 )
31	9.784612	274	9-899370	162	9-885242	436	10-114758	29 5
32	784776	274	899273	162	885503	436	114497	285
₹ 33	784941	274	899176	162	885765	436	114235	27 5
234	785105	274	899078	162	886026	436	113974	26
35	785269	273	898981	162	886288	436	113712	25
36	785433	273	898884	162	886549	435	113451	24
37	785597	273	898787	162	886810	435	113190	23 5
38	785761	273	898689	162	887072	435	112928	22
239	785925	273	898592	162	887333	435	112667	21 5
2 40	786089	273	898494	163	887594	435	112406	20 5
)	1	1						1 (
5 41	9.786252	272	9.898397	163	9-887855	435	10-112145	19 (
\$ 42	786416	272	898299	163	888116	435	111884	18 (
5 43	786579	272	898202	163	888377	435	111623	17 (
5 44	786742	272	898104	163	888639	435	111361	16 (
§ 45	786906	272	898006	163	888900	435	111100	15 (
\$ 46	787069	272	897908	163	889160	435	110840	14 \
5 47	787232	271	897810	163	889421	435	110579	13 }
<b>\ 48</b>	787395	271	897712	163	889682	435	110318	12 }
\$ 49	787557	271	897614	163	889943	435	110057	111 \
<b>50</b>	787720	271	897516	163	890204	434	119796	10 }
5 51	9-787883	271	9-897418	164	9.890465	434	10-109535	9 (
52	788045	e 271	897320	164	890725	434	109275	8 8
53	788208	271	897222	164	890986	434	109014	171
54	788370	270	897123	164	891247	434	108753	6 (
55	788532	270	897025	164	891507	434	108493	5 2
56	788694	270	896926	164	891768	434	108232	4 2
57	788856	270	896828	164	892028	434	107972	3 }
58	789018	270	896729	164	892289	434	107711	2 /
59	789180	270	896631	164	892549	434	107451	117
5 60	789342	269	896532	164	892810	434	107190	10/
5	Cosine	1	Sine	ī	Cotang.	1	Tang.	1 M.
١ . !		!		L	- Coming.	L \		

52 Degrees.

Ň.	Sine	<b>~~~</b>	Cosine	~~ <b>∑</b> .~	Tang.	<b>~~</b> .~~	Cotang.	$\sim$
0	9-789342	269	9-896532	164	9 899810	434	10-107190	, 60
1	789504	269	896433	165	893070	434	106930	59
2	789665	269	896335	165	893331	434	106669	58
3	789827	269	896236	165	893591	434	106409	57
4	789988	269	896137	165	893851	434	106149	56
5 6	790149 790310	269	896038	165	894111	434	105889	55
7	790310	268 268	895939 895840	165 165	894371	434 433	105629	54
8	790632	268	895741	165	894632 894892	433	105368	53 52
9	790793	268	895641	165	895152	433	105108	51
10	790954	268	895542	165	895412	433	104848 104588	50
11	9-791115							
12	791275	268 267	9-895443	166	9-895672	433 433	10-104328	49
13	791436	267	895343 895244	166   166	895932 896192	433	104068	48
14	791596	267	895145	166	896452	433	103808	47
15	791757	267	895045	166	896712	433	103548 103288	46 45
16	791917	267	894945	166	896971	433	103029	44
17	792077	267	894846	166	897231	433	102769	43
18	792237	266	894746	166	897491	433	102509	42
19	792397	266	894646	166	897751	433	102249	41
20	792557	266	894546	166	898010	433	101990	40
21	9-792716	266	9-894446	167	9-898270	433	10.101730	39
22	792876	266	894346	167	898530	433	10101730	38
23	793035	266	894246	167	898789	433	101211	37
24	793195	265~	894146	167	899049	432	100951	36
25	793354	265	894046	167	899308	432	100692	35
26	793514	265	893946	167	899568	432	100432	34
27	793673	265	893846	167	899827	432	100173	33
28	793832	265	893745	167	900086	432	099914	32
29	793991	265	893645	167	900346	432	099654	31
30	794150	264	893544	167	900605	432	099395	30
31	9.794308	264	9-893444	168	9-900864	432	10-099136	29
32	794467	264	893343	168	901124	432	098876	28
33	794626	264	893243	168	901383	432	098617	27
34	794784	264	893142	168	901642	432	098358	26
35	794942	264	893041	168	901901	432	098099	25
36	795101	264	892940	168	902160	432	097840	24
37	795259	264	892839	168	902419	432	097581	23
38	795417	263	892739	168	902679	432	097321	22
39	795575	263	892638	168	902938	432	097062	21
40	795733	263	892536	168	903197	431	096803	20
41	9 795891	263	9.892435	169	9-903455	431	10.096545	19
42	796049	263	892334	169	903714	431	096286	18
43	796206	263	892233	169	903973	431	096027	17
44	796364	262	892132	169	904232	431	095768	16
45	796521	262	892030	169	904491	431	095509	15
46	796679	262	891929	169	904750	431	095250	14
47	796836	262	891827	169	905008	431	094992	13
48 49	796993	262	891726	169	905267	431	094733	12
49 50	797150	261	891624	169	905526	431	094474	111
	797307	261	891523	170	905784	431	094216	10
51	9-797464	261	9-891421	170	9-906043	431	10.093957	9
52	797621	261	891319	170	906302	431	093698	8
53	797777	261	891217	170	906560	431	093440	7
54 55	797934	261	891115	170	906819	431	093181	6
	798091	261	891013	170	907077	431	092923	5
56 57	798247	261	890911	170	907336	431	092664	4
58	798403	260	890809	170	907594	431	092406	3
59	798560	260 260	890707	170	907852	431 430	092148	2
60	798716 798872	260	890605 890503	170 170	908111	430   430	091889 091631	1 0
	190012	200	CHUCUC	110	900309	400	051031	, ,

51 Degrees.

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0	9-798879	260	9-890503	170	9-908369	430	10-091631	160 2
<b>)</b> 1	799028	260	890400	171	908628	430	091379	59 }
2	799184	260	890298	171	908886	430	091114	58
3	799339	259 259	890195	171	909144	430	090856	57 2
5	799495 799651	259	890093 889990	171 171	909402 909660	430 430	090598 090340	56 \
6	799806	259	889888	171	909918	430	090082	\$5 \$4
7	799962	259	889785	171	910177	430	089823	53
S is	800117	259	889682	171	910435	430	089565	52)
9	800272	258	889579	171	910693	430	089307	51)
5 10	800427	258	889477	171	910951	430	089049	50 }
11	9-800582	258	9-889374	172	9-911209	430	10-088791	49 (
12	800737	258	889271	172	911467	430	088533	48 (
13	800892	258	889168	172	911724	430	088276	47 5
14	801047	258	889064	172	911982	430	088018	46 \$
15 16	801201 801356	258 257	888961 888858	172 172	912240	430 430	087760 087502	45 44
17	801511	257	888755	172	912498 912756	430	087244	43 2
is l	801665	257	888651	172	913014	429	086986	42 2
19	801819	257	888548	172	913271	429	086729	1412
20	801973	257	888444	173	913529	429	086471	40 ₹
21	9-802128	257	9-888341	173	9-913787	429	10-086213	39 (
22	802282	256	888237	173	914044	429	085956	38
23	802436	256	888134	173	914302	429	085698	37 5
24	802589	256	888030	173	914560	429	085440	36 (
25	802743	256	887926	173	914817	429	085183	35 5
26 27	802897	256	887822	173	915075	429	084925	34 5
28	803050 803204	256 256	887718 887614	173 173	915332 915590	429 429	084668	33 {
20	803357	255	887510	173	915847	429	084410 084153	31 3
30	803511	255	887406	174	916104	429	083896	30 ₹
31	9-803664	255	9-887302	174	9.916362	429	10.083638	29
32	803817	255	887198	174	916619	1 429	083381	285
33	803970	255	887093	174	916877	429	083123	27 5
34	804123	255	886989	174	917134	429	082866	26 )
(35	804276	254	886885	174	917391	429	082609	25)
36	804428	254	886780	174	917648	429	082352	24)
37	804581	254	886676	174	917905	429	082095	23)
38	804734 804886	254 254	886571 886466	174 174	918163 918420	428 428	081837	22 }
40	805039	254	886362	175	918677	428	081580 081323	20 5
41		254	9-886257			428		1 (
41	9-805191 805343	254 253	886152	175 175	9-918934 919191	428	10-081066	19 3
43	805495	253	886047	175	919191	428	080552	175
44	805647	253	885942	175	919705	428	080295	16)
45	805799	253	885837	175	919962	428	080038	15 2
46	805951	253	885732	175	920219	428	079781	14 9
47	806103	253	885627	175	920476	428	079524	13 2
48	806254	253	885522	175	920733	428	079267	12 }
49	806406	252	885416	175	920990	428	079010	111 (
50	806557	252	885311	176	921247	428	078753	10 }
51	9-806709	252	9-885205	176	9-921503	428	10.078497	9 5
52 53	806860	252	885100	176	921760	428	078240	85
54	807011 807163	252 252	884994 884889	176 176	922017 922274	428 428	077983	76
55	807314	252	884783	176	922530	428	077726 077470	5
56	807465	251	884677	176	922787	428	077213	1 42
57	807615	251	884572	176	923044	428	076956	3 2
58	807766	251	884466	176	923300	428	076700	2 (
59	807917	251	884360	176	923557	427	076443	11
60	808067	251	884254	177	923813	427	076187	105
ì.	Creine	I	Sine	L	Cotang.	<u> </u>	Tang.	I NE.

50 Degrees.

M.	8ine	ĵ Ď.	Conne	~~~~	Tang.	i~D.	Cotang.	~~
0	9-808067	251	9-884254	177	9-923813	427	10-076187	1 60
1	808218	251	884148	177	924070	427	075930	59
2	808368	251	884042	177	924327	427	075673	58
3	808519	250	883936	177	924583	427	075417	57
4	808669	250	883829	177	924840	427	075160	56
	808819 808969	250 250	883723	177	925096	427	074904	55
7	809119	250 250	883617	177	925352	427 427	074648	54
8	809269	250	883510	177 177	925609	427	074391	53
9	809419	249	883404 883297	178	925865 926122	427	074135	52
10	809569	249	883191	178	926378	427	073878 073622	51 50
	1				0.000			1
11 12	9-809718	249 249	9-883084	178	9-926634	427	10 073366	49
13	809868 810017	249	882977 882871	178 178	926890	427 427	073110	48
14	810167	249	882764	178	927147 927403	427	072853 072597	47
15	810316	248	882657	178	927659	427	072341	46
16	810465	248	882550	178	927915	427	072085	44
17	8:0614	248	882443	178	928171	427	071829	43
18	810763	248	882336	179	928427	427	071573	42
19	810912	248	882229	179	928683	427	071317	41
20	811061	248	882121	179	928940	427	071060	40
21	9-811210	248	9.882014	179	9-929196	427	10-070804	39
22	811358	247	881907	179	929452	427	070548	38
23	811507	247	881799	179	929708	427	070292	37
24	811655	247	881692	179	929964	426	070036	36
25	811804	247	881584	179	930220	426	069780	35
26	811952	247	881477	179	930475	426	069525	34
27	812100	247	881369	179	930731	426	069269	33
28	812248	247	881261	180	930987	426	069013	32
29	812396	246	88115 <b>3</b>	180	931243	426	068757	31
30	812544	246	881046	180	931499	426	068501	30
31	9.812692	246	9-880938	180	9-931755	426	10-068245	20
32	812840	246	880830	180	932010	426	067990	28
33	812988	246	880722	180	932266	426	067734	27
34	813135	246	880613	180	932522	426	067478	26
35	813283	246	880505	180	932778	426	067222	25
36	813430	245	880397	180	933033	426	066967	24
37	813578	245	880289	181	933289	426	066711	23
38	813725	245	880180	181	933545	426	066455	22
39	813872	245	880072	181	933800	426	066200	21
40	814019	245	879963	181	934056	426	065944	20
41	9-814166	245	9-879855	181	9-934311	426	10-065689	19
42	814313	245	879746	181	934567	426	065433	18
43	814460	244	879637	181	934823	426	065177	17
44	814607	244	879529	181	935078	426	064922	16
45	814753	244	879420	181	935333	426	064667	15
46	814900	244	879311	181	935589	426	064411	14
47 48	815046	244	879202	182	935844	426	064156	13
49	815193 815339	244 244	879093	182	936100	426	063900	12
50	815485	244	878984 878875	182 182	936355	426 426	063645	111
					936610		063390	10
51	9-815631	243	9-878766	182	9-936866	425	10-063134	9
52 53	815778	243	878656	182	937121	425	062879	8
54	815924	243	878547	182	937376	425	062624	7
55	816069 816215	243 243	878438	182	937632	425	062368	6
56 56	816361	243 243	878328 878219	182 183	937887	425 425	062113	5
50 57	816507	243 242	878219 878109	183	938142	425 425	061858	3
58	816652	242	877999	183	938398 938653	425	061602 061347	2
59	816798	242	877890	183	938908	425	061092	li
60	816943	242	877780	183	939163	425	060837	١ô

49 Degrees.

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30	9-816943	242	9 877780	183	9-939163	425	10-060837	1 60 (
ζi	817068	242	877670	183	939418	425	060582	59 \$
5 2	817233	242	877560	183	939673	425	060327	58 5
5 3	817379	242	877450	183	939928	425	060072	57 5
5 4	817524	241	877340 877230	183 184	940183 940438	425 425	059817 059562	56 5
\ 5 6	817668 817813	241 241	877120	184	940694	425	059306	54
7	817958	241	877010	184	940949	425	059051	53 }
( å	818103	241	876899	184	941204	425	058796	52
٧ŏ	818247	241	876789	184	941458	425	058542	51 (
( 1ŏ	818392	241	876678	184	941714	425	058286	50 (
5 11	9-818536	240	9 876568	184	9-941968	425	10-058032	49 5
12	818681	240	876457	184	942223	425	057777	48
(13	818825	240	876347	184	942478	425	057522	47)
14	818969	240	876236	185	942733	425	057267	46 >
) 15	819113	240	876125	185 185	942988	425 425	057012	45
16	819257	240	876014	185	943243 943498	425 425	056757 056502	44 }
17	819401 819545	240 239	875904 875793	185	943752	425	056248	42 3
10	819689	239	875682	185	944007	425	055993	41 5
20	819632	239	875571	185	944262	425	055738	40 5
21	9.819976	239	9-875459	185	9-944517	425	10-055483	39 \$
22	820120	239	875348	185	944771	424	055229	38
323	820263	239	875237	185	945026	424	054974	37
5 24	820406	239	875126	186	945281	424	054719	36 )
25	820550	238	875014	186	945535	424	054465	35 2
26	820693	238	874903	186	945790	424	054210	34 2
27	820836	238	874791	186	946045	424	053955	33 (
28	820979	238	874680	186	946299	424	053701	32 \
29	821122	238	874568	186 186	946554 946808	424 424	053446 053192	31 }
<b>30</b>	821265	1	874456					
(31	9-821407	238	9-874344	186	9-947063	424 424	10·052937 052682	29 6
35	821550	238	874232 874121	187 187	947318 947572	424 424	052428	27 2
33	821693 821835	237	874009	187	947826	424	052174	26 2
35	821977	237	873896	187	948081	424	051919	25 2
36	822120	237	873784	187	948336	424	051664	24 2
37	822262	237	873672	187	948590	424	051410	23 (
>38	822404	237	873560	187	948844	424	051156	22 (
39	822546	237	873448	187	949099	424	050901	21 (
<b>}</b> 40	822688	236	873335	187	949353	424	050647	20 (
₹41	9-822830	236	9-873223	187	9-949607	424	10.050393	19 \$
(42	822972	236	873110	188	949862	424	050138	18
₹43	823114	236	872998	188	950116 950370	424 424	049884 049630	17 5
\ 44 45	823255 823397	236 236	872885 872772	188 188	950370	424 424	049375	15
46	823539	236	872659	188	950879	424	049121	143
5 47 47	823680	235	872547	188	951133	424	048867	133
48	823821	235	872434	188	951388	424	048612	12 5
49	823963	235	872321	188	951642	424	048358	115
2 50	824104	235	872208	188	951896	424	048104	10 5
( 51	9.824245	235	9-872095	189	9.952150	424	10-047850	9)
( 52	824386	235	871981	189	952405	424	047595	3)
53	824527	235	871868	189	952659	424	047341	7?
54	824668	234	871755	189	952913	424	047087	6)
55	824808	234	871641	189	953167	423 423	046833	5 }
56 57	824949 825090	234 234	871528 871414	189 189	953421 953675	423	046579 04632 <b>5</b>	35
58	825230	234	871301	189	953929	423	046071	1 25
₹ 59	825371	234	871187	189	954183	423	045817	1 115
860	825511	234	871073	190	954437	423	045565	1 65
-	1 Cosine	<u> </u>			Cotang.	1	Tang.	1 M.
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3 R25931 233 870732 190 955900 423 044506 57 4 826971 233 870504 190 955454 423 044566 56 6 826351 233 870390 190 955901 423 044039 34 7 826491 233 870390 190 955901 423 044039 34 8 826631 233 870161 190 956499 423 044039 34 9 829770 232 870047 191 956723 423 043331 52 10 826910 232 889933 191 956977 423 043023 50 11 9827049 233 978047 191 956723 423 043023 50 11 9827049 233 868569 191 956721 423 10-042769 49 11 9827049 233 868569 191 957739 423 042515 49 11 9827049 238 868569 191 957739 423 042515 49 11 9827054 233 868569 191 957739 423 042515 49 11 827785 233 868569 191 957739 423 042515 47 11 827864 231 868130 191 958906 423 04150 44 827467 233 868676 191 958906 423 04150 44 827467 233 868676 191 958906 423 04150 44 827467 233 868670 192 959022 423 041946 43 15 827864 231 869130 191 958764 423 041946 43 16 827745 232 869265 192 959022 423 041946 43 17 827864 231 869130 191 958764 423 041946 43 18 828022 231 869015 192 959022 423 040738 41 19 827869 231 869670 192 990023 423 040738 41 20 822801 231 869676 192 990023 423 040738 41 21 9828439 231 9868670 192 990576 423 10-04021 39 825716 231 869670 192 990577 423 039977 38 22 825878 231 868555 192 980674 423 004084 40 21 982855 230 868394 192 960531 423 039977 38 28 825716 231 868670 192 990577 423 039977 38 28 8258716 231 868670 192 990577 423 039977 38 28 8258716 231 868670 192 990574 423 039977 38 28 8258716 231 868670 193 996084 423 039973 37 38 830784 229 867799 193 9961991 423 039978 37 39 829545 230 868699 192 960784 423 039973 37 30 829663 230 869099 192 960784 423 039973 37 30 829663 230 869099 192 960784 423 039973 37 31 9829621 230 869699 192 960784 423 039973 37 32 8258716 231 869686 194 964884 423 039489 36 38 830991 229 866790 194 966869 423 039489 36 38 830991 229 867899 193 962690 423 038981 31 39 829545 229 867899 193 962690 423 038981 31 30 823682 228 866870 194 964881 423 038485 32 31 823699 229 867691 194 963686 422 033486 19 31 831409 228 866890 194 964834 422 033481 11 31 982821 229 866863 195 966869 422 033486 62 31 831749 228 866890 195	ì	825651	233	870960	190	954691	423		
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32         839959         229         867309         193         962500         423         037440         28           33         830097         229         8671283         193         962813         423         037187         27           34         830234         229         8671071         193         9632920         423         036680         25           35         830372         229         866935         194         963574         423         036680         25           36         830509         229         866819         194         963574         423         036173         23           37         830646         229         866819         194         964031         423         035919         22           30         830921         228         866703         194         964031         423         035919         22           40         831058         228         866470         194         964881         422         035412         20           41         9831195         228         866120         194         965955         422         034851         17           42         831369         228		-		i .	1				
33   830097   229   8670283   193   962813   423   037187   27 ( 34   830234   229   867167   193   963030   423   036680   25 ( 35   830372   229   867051   193   963320   423   036680   25 ( 36   830509   229   866825   194   963327   423   036680   25 ( 37   830646   229   866819   194   963827   423   036486   24 ( 38   830784   229   866819   194   96481   423   035919   22 ( 40   831058   228   866566   194   964051   423   035919   22 ( 40   831058   228   866566   194   964355   423   035615   24 ( 41   9631195   228   866533   194   996458   422   035412   90 ( 41   9631195   228   866533   194   9964842   422   10-035158   19 ( 42   831333   228   86627   194   965055   422   034651   17 ( 44   831606   228   866190   194   965349   422   034651   17 ( 44   831606   228   866190   194   965349   422   034651   17 ( 45   831742   228   86587   195   965855   422   034485   15 ( 46   831879   228   865563   195   966610   422   033681   15 ( 48   832152   227   865563   195   966616   422   033681   12 ( 49   832288   227   865506   195   966616   422   033681   12 ( 49   832288   227   865302   195   967123   422   033381   12 ( 49   83288   227   865302   195   967123   422   033381   12 ( 49   83288   227   865306   195   967623   422   033381   12 ( 49   83288   227   865306   195   967623   422   033381   12 ( 49   83288   227   865306   195   967623   422   033331   16 ( 49   83288   227   865306   195   967623   422   033313   17 ( 40   833697   227   865068   195   967623   422   033131   16 ( 40   833697   227   865068   195   967623   422   033131   16 ( 40   833697   227   865068   195   967623   422   033131   16 ( 40   833697   227   865068   195   967623   422   033131   16 ( 40   833697   227   865068   195   967623   422   033131   16 ( 40   833697   227   865068   195   966666   422   033331   16 ( 40   833697   227   865068   195   966660   422   033331   16 ( 40   833697   227   865068   195   966660   422   033331   16 ( 40   833648   226   864433   196   969656   422   031611   5 (			900						
34         830234         229         867107         193         963067         423         039633         26           35         830379         229         867051         193         963320         423         036680         25           36         830509         229         866819         194         963574         423         036436         24           37         830646         229         866710         194         963574         423         036173         23           38         830784         229         866703         194         964031         423         035919         22           39         830921         228         866586         194         964335         423         035665         21           40         831059         228         866570         194         964588         422         035412         30           41         9831195         228         966333         194         965085         422         034915         18           42         831332         228         866237         194         965085         422         034935         18           43         831606         228			990						
35         830372         229         867051         193         963320         423         036486         25           37         830646         229         866835         194         963874         423         036486         24           38         830784         229         866819         194         963827         423         036173         23           38         830784         229         866866         194         964081         423         033919         22           40         831058         228         866470         194         964385         422         035412         90           41         9831195         228         966333         194         9964842         422         1035412         90           42         8313332         228         866237         194         9964842         422         1035188         19           43         831469         228         866120         194         965349         422         034651         17           44         831606         228         866120         194         965354         422         034388         16           45         831742         228									
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38         \$\begin{array}{c} \text{307} \text{92} \\ \text{866703} \\ \text{808} \end{array}\$          \$194         \$\text{964031} \\ \text{423} \\ \text{035619} \\ \text{923} \\ \text{035619} \\ \text{923} \\ \text{035665} \\ \text{21} \\ \text{035655} \\ \text{21} \\ \text{035412} \\ \text{30} \\ \text{30056} \\ \text{22} \\ \text{035412} \\ \text{305655} \\ \text{22} \\ \text{035485} \\ \text{305655} \\ \text{22} \\ \text{035485} \\ \text{305655} \\ \text{22} \\ \text{035485} \\ \text{305655} \\ \text{22} \\ \text{035861} \\ \text{305655} \\ \text{22} \\ \text{035861} \\ \text{3056565} \\ \text{227} \\ \text{86563} \\ \text{30565} \\ \text{3056610} \\ \text{422} \\ \text{033681} \\ \text{3056565} \\ \text{3056565} \\ \text{3056565} \\ \text{3056556} \\ \text{3056556} \\ \text{3056565} \\ \text{30566666} \\ \text{305666666} \\ \text{3056666666} \\ \text{3056666666} \\ \text{3056666666} \\ \text{305666666} \\ \text{305666666} \\ \text{3056666666} \\ \text{30566666666} \\ 305666666666666666666666666666666666666		830509			194				24 (
39         830921         228         866586         194         964335         423         035665         21           40         831058         228         866470         194         964588         422         035412         30           41         9 831195         228         9 866333         194         965005         422         10-035158         18           42         831332         228         866120         194         965005         422         034905         18           43         831469         228         866120         194         965305         422         034381         18           45         831742         228         866120         194         9653349         422         034388         18           45         831742         228         86587         195         965855         422         034388         11           46         831879         228         86587         195         966362         422         033638         13           47         832015         227         865633         195         966362         422         033638         13           48         832152         227									
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41         9-831195         228         9-86353         194         9-964842         422         10-035158         19           42         831332         228         866120         194         965095         422         034905         18           43         831469         228         866120         194         965369         422         034651         18           44         831606         228         866004         195         965002         422         034386         16           45         831742         228         865887         195         965855         422         034145         15           47         832015         227         865633         195         96609         422         033881         14           48         832152         227         865419         195         96609         422         033381         11           49         832288         227         865302         195         966109         422         033331         11           50         832425         227         865302         195         967123         422         032331         11           51         9832561         227									
42         831332         228         866237         194         965095         422         034905         18           43         831469         228         866120         194         965304         422         034651         17           44         831606         228         866120         195         965002         422         034396         16           45         831742         228         865770         195         965855         422         034145         15           46         831679         228         865770         195         966302         422         033681         15           47         832015         227         865533         195         966302         422         033681         13           48         832152         227         865303         195         966609         422         033313         11         19         966699         422         033313         12         50         832452         227         865302         195         967123         422         032877         10         50         50         967629         422         033131         11         50         832867         227         965085	1								l )
43         831469         928         866190         194         965349         422         034651         17           44         831606         228         866004         195         965602         422         034396         16           45         831742         228         865867         195         965853         422         034145         15           46         831879         228         8658770         195         966109         422         033681         13           48         832152         227         86533         195         96616         422         033681         12           49         832928         227         865302         195         96616         422         033341         12           50         832425         227         865302         195         967123         422         033877         10           51         983261         227         965308         195         997723         422         032877         10           52         83697         227         965308         195         997783         422         10703984         9           53         838833         227 <t< td=""><td></td><td></td><td>228</td><td></td><td></td><td></td><td></td><td></td><td></td></t<>			228						
44         831606         228         866004         195         965002         422         034398         16           45         831742         228         865897         195         965855         422         034145         15           46         831879         228         865770         195         966009         422         033891         14           47         832015         227         865633         195         966302         422         033891         13           48         832152         227         865536         195         966809         422         033381         13           49         832288         227         865302         195         967123         422         0333131         11           50         832425         227         865302         195         967123         422         003277         10           51         9832561         227         965185         195         967629         422         003271         8           52         832697         227         86508         195         967829         422         032117         7           54         832999         226         <									1 #2 (
45         831742         292         865867         195         965855         422         034145         15           46         831879         228         865770         195         966109         422         033891         14           47         832015         227         865633         195         96616         422         033384         12           48         832152         227         865302         195         966616         422         033334         12           50         832425         227         865302         195         967123         422         033131         11           51         983251         227         965302         195         967723         422         032877         10           52         833697         227         965008         195         967629         422         032371         0           53         838233         227         864950         195         967629         422         032317         7           54         832999         226         864950         195         967839         422         031844         6           55         833105         226			999						
46         831879         928         855770         195         966109         422         033891         14           48         832152         227         865653         195         966616         422         033381         13           49         832286         227         865302         195         966616         422         033384         13           50         832425         227         865302         195         966969         422         033131         11           51         9832856         227         965302         195         967123         422         032877         10           52         838897         227         965308         195         967629         422         032371         8           52         838997         227         865068         195         967823         422         03217         7           54         832999         226         86433         196         968136         422         03217         7           55         833941         226         864716         196         96899         422         03187         6           56         833941         226         8643									
47         839015         927         865633         195         966392         422         033688         13           48         832152         227         865363         195         966616         422         033884         12           49         832288         227         865302         195         966609         422         033131         11           50         832425         227         865302         195         967123         422         003277         10           51         963261         227         965308         195         967629         422         0032871         10           52         833697         227         86508         195         967629         422         10-032624         9           53         832833         227         864930         195         967683         422         032117         7           54         833969         226         864931         196         96389         422         031611         5           55         833105         226         864716         196         968896         422         031611         5           57         833377         226 <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>									
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50         83949.5         927         965302         195         967123         422         032877         10           51         9-832561         927         9485185*         195         9-967376         422         10-039894         9           52         838697         227         865068         195         967629         422         032371         8           53         838833         297         864950         195         967883         492         032117         7           54         832969         296         864333         196         96136         422         031117         7           55         833105         226         864716         196         968389         422         031611         5           56         833271         226         864586         196         9689643         422         031337         4           57         833377         226         864363         196         969149         422         031104         3           58         833512         226         864363         196         969149         422         030161         2           59         833684         226		832152	227		195				
51         9-832561         227         9-865185         195         9-967376         422         10-032624         9           52         832697         227         864080         195         967629         422         032371         8           53         832833         227         864950         195         967833         422         032117         7           54         832969         226         864833         196         968136         422         031864         6           55         833105         226         864716         196         968399         422         031611         5           56         833941         226         864481         196         96896         422         031104         3           57         833377         226         864363         196         969149         422         030851         2           58         833512         226         864363         196         969149         422         030851         2           59         833648         226         864245         196         969656         422         03057         1           60         833783         226 <t< td=""><td></td><td></td><td>227</td><td></td><td>195</td><td></td><td></td><td></td><td></td></t<>			227		195				
52         838897         227         865068         195         967629         422         0323717         8           54         832949         226         864950         195         967883         422         032117         7           54         832949         226         864833         196         968136         422         031804         6           55         833105         226         864716         196         968399         422         031611         5           56         833941         226         864598         196         968963         422         031357         4           57         833377         226         864481         196         96896         422         03104         3           58         833512         226         864363         196         969149         422         030851         2           59         833648         226         864245         196         969456         422         03057         1           60         833783         226         864127         196         969656         422         03044         0				865302		967123			
53         839833         927         884959         195         967883         4922         032117         7           54         832969         926         864833         196         968136         422         031864         6           55         833105         226         864716         196         968369         422         031611         5           56         833277         226         864596         196         968643         422         031337         4           57         833377         226         864361         196         968964         422         031104         3           58         833512         226         864363         196         969149         422         030651         2           59         833684         226         864925         196         969403         422         030571         1           60         833783         226         864127         196         969656         422         030344         0			227						
54         832969         226         664833         196         968136         422         031864         6           55         833105         226         864716         196         968399         422         031611         5           56         8339241         226         864588         196         968643         422         031357           57         833377         226         864481         196         968696         422         031104         3           58         833512         226         864363         196         999149         422         030851         2           59         833648         226         864245         196         969656         422         030571           60         833783         226         864127         196         969656         422         03044         0									8 (
55         833105         226         884716         196         988390         422         031611         5           56         833241         226         864598         196         968643         422         031357         4           57         833377         226         864491         196         968966         422         03104         3           58         833512         226         864363         196         969149         422         030851         2           59         833648         226         864245         196         969403         422         030597         1           60         833783         226         864127         196         969656         422         030344         0									
56     833241     226     864598     196     968643     422     031357     4       57     833377     226     864481     196     968696     422     031104     3       58     833512     226     864363     196     969149     422     030651     2       59     833648     226     864245     196     969403     422     030597     1       60     833783     226     864127     196     969656     422     030344     0									
57         833377         226         684481         196         968896         422         031104         3           58         833512         226         864363         196         999149         422         030851         2           59         833648         226         864245         196         999403         422         030597         1           60         833783         226         864127         196         969656         422         030344         0			996						
58     833512     226     864363     196     969149     422     030851     2       59     833648     226     864245     196     969403     422     030597     1       60     833783     226     864127     196     969656     422     030344     0									35
59         833648         226         864245         196         969403         422         030597         1           60         833783         228         864127         196         969656         422         030344         0									
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47 Degrees.

0         9*833783         226         9*864127         196         9*969656         422         10*030344         60           1         833919         225         864010         196         969909         422         030091         59           2         834054         225         863802         197         970162         422         029383         58           3         834169         225         863774         197         970416         422         029383         58           4         834325         225         863538         197         970669         422         029331         56           5         834460         225         863538         197         970922         422         029078         55           6         834595         225         863419         197         971175         422         028825         54           7         834730         225         863183         197         971692         422         022871         53           8         834865         225         863183         197         971692         422         022871         52           9         834999         224         <	۲m.	8me	~~~~	Cosine	~~~~	Tang.		Cotang.	~~
2         834054         925         863902         197         970162         492         029384         58           3         831489         925         883734         197         970469         422         029331         56           4         834325         925         863538         197         970492         422         029078         55           6         834595         925         8633301         197         971429         422         029078         55           7         834730         925         863331         197         971429         422         028255         54           9         834999         924         863064         197         971835         422         028318         52           10         835134         224         868296         198         972484         422         0227132         49           11         9835939         924         982590         198         973944         422         027306         43           12         883543         224         886290         198         973901         422         027306         43           13         815538         224 <td< td=""><td>)</td><td></td><td></td><td>9-864127</td><td>196</td><td>9-969656</td><td></td><td></td><td><u> </u></td></td<>	)			9-864127	196	9-969656			<u> </u>
3         834189         925         683774         197         970416         422         023844         57           4         834325         255         863338         197         970699         422         029331         56           6         834460         925         863338         197         971175         422         028371         53           7         834730         225         863183         197         971175         422         028318         53           9         834999         224         863046         197         971835         422         028318         52           10         835134         224         862046         198         972188         422         027512         50           11         983599         224         862590         198         979244         422         10077559         49           12         863603         224         862590         198         972948         422         027054         43           13         835507         224         862333         198         973474         422         026796         45           15         835941         224 <td< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></td<>									
4         834325         225         863536         197         970669         422         029331         56           5         834460         225         863338         197         971175         422         029825         54           6         834595         225         863301         197         9711429         422         028318         52           7         834790         224         863064         197         971622         422         028318         52           9         834999         224         863064         197         971835         422         028318         52           10         835134         224         862506         188         972188         422         027512         51           11         983569         224         9682590         198         972441         422         1070356         49           12         835672         224         862253         188         973454         422         027326         47           15         835677         224         86233         188         973707         422         026343         423         026164         43           16 <td< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></td<>									
5         834460         225         863538         197         970922         422         020078         55           6         834505         225         863319         197         971175         422         028825         54           7         834730         225         863183         197         971682         422         028318         20           8         834865         225         863183         197         971835         422         022615         53           10         835134         224         862046         198         972186         422         027012         50           11         983599         224         862060         198         972804         422         1027306         48           12         835403         224         862501         198         973401         422         027052         47           14         835672         224         862353         198         973474         422         026546         43           15         835807         224         862353         198         973474         422         0266799         46           15         8356673         223         <									
6         834595         295         863419         197         971175         492         028825         54           7         73479         925         863301         197         971692         422         028571         53           8         834865         225         863183         197         971692         422         028018         32           10         835134         224         862046         198         972188         422         026055         51           11         983599         224         9662927         198         9739441         422         10-027559         49           12         835403         224         862709         198         973948         422         10-027559         49           13         835538         224         862590         198         973948         422         027052         47           15         83507         224         862333         198         9734707         422         026043         43           16         835941         224         862333         198         973707         422         026044         44           17         36075         223									
8         83/4730         925         863/301         197         971/489         422         028571         52           9         83/4999         224         863064         197         971/893         422         028318         52           10         835134         224         863064         197         971/893         422         022015         52           11         9835899         224         9682897         198         973844         422         10-027/559         43           12         835403         224         8682709         198         973844         422         0277052         47           13         83538         224         862590         198         973844         422         0277052         47           15         835607         224         862333         198         973454         422         026594         45           16         835941         224         862333         198         973454         422         026640         43           17         536075         223         861817         198         974466         422         025787         44           18         33699         223 <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>									
6         8 634665         225         863163         197         971693         422         0263165         52, 4         603064         197         971893         422         0263065         51, 4         198         972188         422         027812         50, 6         50, 6         11         9835699         224         8662946         198         972188         422         027812         50, 6         20, 70, 6         42, 2         10, 727559         40, 6         20, 70, 6         42, 2         10, 727559         40, 6         20, 70, 6         40, 7         20, 70, 6         40, 7         20, 70, 6         40, 7         20, 70, 6         40, 7         20, 70, 6         40, 7         20, 70, 6         40, 7         20, 70, 7         40, 7         20, 70, 5         40, 7         20, 70, 7         422         027052         47, 7         40, 7         20, 70, 7         422         027052         47, 7         41, 7         10, 7         20, 70, 7         422         027052         47, 7         41, 7         10, 7         20, 70, 7         422         027052         41, 7         11, 7         20, 70, 7         422         027052         42, 7         20, 70, 7         422         027052         41, 7         42, 7         20, 70,									
10   635134   224   862946   198   972188   423   027812   50   11   9835299   224   862709   198   972441   422   10-027559   49   12   633403   224   862709   198   972948   422   027052   47   48   48   48   48   48   48   48			225	86318 <b>3</b>	197	971682	422	028318	
11   9835269   224   9-862827   198   9-972441   422   10-027559   49     12   835403   224   862709   198   972848   422   027306   48     13   835538   224   862599   198   972848   422   027306   48     14   835672   224   862353   198   973454   422   026799   46     15   835907   224   862353   198   973454   422   026546   45     16   835941   224   862234   198   973707   423   026246   45     17   836075   223   861986   198   973707   422   026546   45     18   836299   223   861986   198   974213   422   025554   41     19   836343   223   861758   199   9744719   422   025534   41     21   9836611   223   9861638   199   9744719   422   025281   40     22   836745   223   861807   199   975226   422   025257   42     23   836876   223   86180   199   975226   422   024581   37     24   837012   222   861260   199   975479   422   024581   37     25   837146   222   861161   199   975826   422   024581   37     26   837279   222   860161   199   976491   423   022762   34     27   837412   222   860602   199   976744   422   02256   32     28   837546   222   860602   199   976744   422   02256   32     29   837679   222   860602   199   976874   422   022003   31     29   837679   222   860602   200   977250   422   022003   31     20   83745   222   860602   200   977850   422   022003   31     20   83745   222   860602   200   977850   422   022003   31     21   838344   221   860622   200   977850   422   022003   31     23   838078   221   859601   200   977851   422   022003   31     24   83844   221   869602   200   977851   422   022003   31     25   83745   222   860602   200   977850   422   022003   31     25   83746   222   860602   200   977850   422   022003   31     26   837945   222   860602   200   977850   422   022003   31     27   834594   221   85960   200   977850   422   022003   31     28   838078   221   85960   200   977850   422   022003   31     28   838078   221   85960   200   977850   422   022003   31     33   838078   221   85960   200   978505   421   01600   420	( 9	834999							51 (
13	10	835134	224	862946	198	972188	422	027812	50 <b>⟨</b>
13	) 11	9.835269							49 (
14         835679         224         862471         198         973501         422         026799         46           15         835807         224         862353         198         973454         423         026546         45           16         835941         224         862234         198         973707         423         026946         44           17         836075         223         861996         198         973900         422         025534         44           18         836299         223         861976         198         974413         422         025534         41           19         836343         223         861758         199         974719         422         025534         41           21         9 836611         223         961638         199         974779         422         0245534         41           22         836745         223         861400         199         975479         422         024588         36           25         857146         222         861061         199         975638         423         024078         34           27         837412         222									
15   835807   224   862333   198   973454   429   028546   45   16   835941   224   862234   198   973707   422   028034   44   17   836075   223   862115   198   973806   422   028046   43   43   43   43   43   43   43									
16         835941         294         869224         196         973707         429         029293         44           17         836075         223         861196         198         973907         429         029290         43           18         836209         223         861986         198         974213         422         025787         42           19         836343         223         861788         199         974419         422         025281         40           21         983611         223         961638         199         9744719         422         025281         40           22         836745         223         961400         199         975479         422         024774         38           24         837012         222         861161         199         975266         422         024368         36           25         837146         222         861061         199         975265         422         024058         36           27         837412         222         860692         199         976491         422         023762         34           28         837679         222									
17   \$28075   \$223   \$61996   198   \$973960   \$422   \$025040   \$43   \$43   \$43   \$45   \$05   \$25   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$45   \$									
18   \$36209   \$223   \$61996   198   \$974913   \$422   \$025767   \$42   \$20   \$25767   \$42   \$20   \$25814   \$41   \$20   \$25814   \$41   \$23   \$23   \$61877   198   \$974466   \$422   \$025234   \$41   \$21   \$986613   199   \$974719   \$422   \$025234   \$41   \$21   \$986613   199   \$974973   \$429   \$025027   30   \$22   \$836745   \$223   \$861519   199   \$975296   \$422   \$024521   37   \$223   \$861519   199   \$975296   \$422   \$024521   37   \$2587146   \$222   \$861616   199   \$975296   \$422   \$024521   37   \$2587146   \$222   \$861161   199   \$975826   \$422   \$02408   36   \$25   \$87146   \$222   \$861161   199   \$975826   \$422   \$02408   36   \$25   \$87146   \$222   \$861061   199   \$976826   \$422   \$02403   33   \$27   \$87412   \$222   \$860092   199   \$976491   \$422   \$023762   34   \$27   \$87412   \$222   \$860692   199   \$976491   \$422   \$023762   34   \$28   \$87546   \$222   \$860692   199   \$97644   \$422   \$023763   34   \$28   \$837679   \$222   \$860692   200   \$977250   \$422   \$022036   32   \$28   \$837812   \$222   \$860822   200   \$977503   \$422   \$022036   32   \$38   \$83878   \$221   \$860822   200   \$977750   \$422   \$0220736   33   \$38211   \$21   \$860822   200   \$977756   \$422   \$02244   \$28   \$33   \$83877   \$21   \$860822   200   \$977503   \$422   \$022173   \$36   \$38   \$38477   \$21   \$89993   200   \$97809   \$423   \$021991   \$27   \$36   \$83847   \$21   \$89842   200   \$978768   \$422   \$021738   \$26   \$37   \$38742   \$21   \$859912   200   \$978768   \$422   \$021738   \$26   \$37   \$38742   \$21   \$859912   201   \$979274   \$422   \$021738   \$26   \$37   \$38742   \$21   \$85990   200   \$978768   \$422   \$021738   \$26   \$37   \$388742   \$21   \$859812   200   \$978768   \$422   \$021738   \$26   \$388742   \$21   \$85980   201   \$979780   \$422   \$021738   \$26   \$37   \$388742   \$21   \$85980   201   \$979780   \$422   \$021738   \$26   \$388742   \$21   \$85980   201   \$979780   \$422   \$021738   \$26   \$388742   \$21   \$85980   \$20   \$98535   \$421   \$018450   \$13   \$48880   \$20   \$85875   \$20   \$98053   \$421   \$018450   \$13   \$48880   \$20   \$85875   \$20   \$98053   \$421   \$018603									
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90   836477   223   8661758   199   974719   422   025281   40			223				422		
21   9836611   223   9861638   199   9-974973   429   10-025097   39									
22   836745   223   861519   199   975926   429   024774   38   23   836878   223   861400   199   975739   422   024528   36   25   837146   222   861260   199   975733   422   024528   36   25   837146   222   861161   199   975823   422   024528   36   26   837279   222   861041   199   976238   422   022509   33   227   837419   222   860922   199   976491   422   022509   33   228   837546   222   8609692   199   976744   423   022356   32   29   837679   222   860682   200   976997   422   022509   33   33   33   33   33   222   860563   200   977250   422   022750   33   33   33   33   33   33   33	21	9 836611	223	9-861638	199	9-974973	423	10-025027	ı <i>,</i>
23   836876   223   861400   199   975739   422   024521   37   024   837012   222   861161   199   975733   422   024015   35   025   837146   222   861161   199   975985   422   024015   35   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   027   02								024774	
25   837146   222   861161   199   975985   423   024015   35   35   35   35   37   37412   222   860922   199   976491   423   023563   34   32   023762   34   32   023763   34   32   023763   34   32   023763   34   32   023763   34   32   023763   34   32   023563   35   35   35   35   35   35   35	23	836878		861400					37
98         637279         922         861041         199         976838         422         023763         34           97         837412         922         860922         199         976491         422         023763         34           28         837546         222         860602         199         976744         423         023256         32           30         837812         222         860562         200         977250         422         02303         31           31         9837945         222         960448         200         977753         422         10022497         29           32         838078         221         860202         200         977809         422         022191         27           34         838344         221         860202         200         978282         422         021738         26           35         83477         221         859699         200         978515         422         021438         21           36         838610         221         859421         200         978515         422         021273         23           38         838752         221									
97   837419   922   860923   199   976491   429   022509   32   32   33   33   33   33   33   3									
293         837546         222         800603         199         976744         423         023256         32           299         837679         222         800623         200         977897         422         022033         31           30         837812         222         800503         200         977750         422         022750         30           31         9837945         221         860322         200         977756         422         022247         23           32         838078         221         860232         200         977503         422         022144         23           33         838211         221         860202         200         977809         422         021991         27           34         838344         221         859993         200         978515         422         021738         26           36         838610         221         859842         200         978768         422         021232         24           33         838742         221         859601         201         979274         422         020736         22         38         838007         221         859400									
29         837679         222         800682         200         978997         423         022003         31           30         837812         222         860562         200         977250         422         022750         33           31         9837945         222         9860442         200         9777563         422         10022497         29           32         838078         221         860322         200         9777564         422         022244         23           33         838211         221         860322         200         978009         422         021738         26           34         838344         221         869612         200         978515         422         021738         26           36         83610         221         859842         200         978768         422         021485         25           37         818742         221         859601         201         979527         422         020979         23           38         838875         221         859601         201         979780         422         020473         21           41         0239404         220									
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31         9-837945         222         9-800442         200         9-977503         422         10-032497         29           32         838078         221         860302         200         977009         422         022244         28           33         838211         221         860009         200         978009         422         021939         27           34         838344         221         859092         200         978768         422         021435         23           36         838610         221         859842         200         978768         422         021435         23           38         838742         221         859601         201         979274         422         020979         32           38         83875         221         859601         201         979527         422         020733         21           40         839140         220         859300         201         979780         422         020733         21           41         9839272         220         9859239         201         996033         429         10-019967         19           42         839404         220<									
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33         838211         921         890202         900         978009         422         021991         27           34         838344         221         860022         200         978262         422         021991         27           35         838477         221         859932         200         978515         422         021485         25           36         838610         221         859422         201         979021         422         021232         94           37         838742         221         859421         201         979021         422         020796         22           38         838675         221         859601         201         979274         422         020736         22           39         839007         221         859480         201         979780         422         020736         22           40         839140         220         859360         201         979780         422         020796         22           42         839404         220         859119         201         98038         429         019971         18           43         839536         220         <									
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38         838875         521         859601         901         979274         4292         020736         52           39         839007         221         859480         201         979527         423         0204733         21           40         839140         220         859360         201         979780         422         020220         20           41         9839272         220         985929         201         9980033         429         10-019967         19           42         839404         220         859119         201         980538         429         019714         18           43         839536         220         858969         201         980538         429         019462         17           44         839608         220         858956         202         981044         421         019209         16           45         839900         220         858635         202         981044         421         018703         14           47         84004         219         858514         202         981550         421         018403         13           48         840196         219									
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43         839536         920         859968         901         980538         429         019462         17           44         839608         220         858777         201         980791         421         019900         16           45         839900         220         858778         202         981044         421         018956         15           46         839932         220         858514         202         981550         421         018703         14           47         84004         219         858514         202         981550         421         018450         13           48         840196         219         858927         202         981803         421         018197         12           49         844328         219         858151         202         982306         421         017691         10           51         9-840591         219         9580292         202         998256         421         017491         11           52         840722         219         857906         202         982564         421         017488         9           53         840854         219									
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38     841509     218     857178     2903     984331     421     015669     2       50     841640     218     857056     2903     984384     421     015466     1       60     841771     218     856934     203     984837     421     015163     1									
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\ 2 3	842033 842163	218	856690	204	985343	421 421	014657	58 /
5 4	842294	217 217	856568 856446	204 204	985596 985848	421	014404 014152	56 /
> 3	842424	217	856323	204	986101	421	013899	55 >
2 6	842555	217	856201	204	986354	421	013646	54 2
7	842685	217	856078	204	986607	421	013393	53 2
<b>₹</b> 8	842815	217	855956	204	986860	421	013140	52 }
<b>7</b> 9	842946 843076	217 217	855833 855711	204 205	987112 ' 987365	421 421	012888 012635	51 50
(11	9-843206	216	9-855588	205	9-987618	421	10-012382	49 {
12	843336	216	855465	205	987871	421	012129	48
₹ 13	843466	216	855342	205	988123	421	011877	47 (
( 14	843595	216	855219	205	988376	421	011624	46 (
( 15	843725	216	855096	205	988629	421	011371	45 (
( 16 ( 17	843855	216	854973	205	988882	421	011118	144 5
2 18	843984 844114	216 215	854850 854727	205 206	989134 989387	421 421	010866 010613	43 {
₹ 19	844243	215	854603	206	989640	421	010360	141 (
(20	844372	215	854480	206	989893	421	010107	40 (
( 21	9-844502	215	9-854356	206	9-990145	421	10-009855	39
5 22	844631	215	854233	206	990398	421	009602	38 \$
5 23	844760	215	854109	206	990651	421	009349	37 >
24	844889	215	853986	206	990903	421	009097	36 >
26	845018 845147	215 215	853862 853738	206 206	991156 991409	421 421	008844 008591	35 34
₹ 27	845276	214	853614	207	991662	421	008338	33 (
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∫ 30	845662	214	853242	207	992420	421	007580	30 >
31	9-845790	214	9-853118	207	9-992672	421	10-007328	29 >
32	845919	214	852994	207	992025	421	007075	28 (
33	846047 846175	214 214	852869 852745	207 207	993178 993430	421 421	006822	27 }
35	846304	214	852620	207	993683	421	006317	25
36	846432	213	852496	208	993936	421	006064	24
37	846560	213	852371	208	994189	421	005811	23 >
38	846688	213	852247	208	994441	421	005559	22 )
40	846816 846944	213 213	852122 851997	208 208	994694 994947	421 421	005306 005053	21 20 20 20
41		213		208		421	10 004801	1 ~ (
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43	847327	213	851622	208	995705	421	004295	17 2
2 44	847454	212	851497	209	995957	421	004043	16 (
₹ 45	847582	212	851372	209	996210	421	003790	15 (
3 46 47	847709	212	851246	209	996463	421	003537 003285	14 3
48	847836 847964	212 212	851121 850996	209 209	996715 996968	421 421	003032	13 (
49	848091	212	850870	209	997221	421	002779	1112
50	848218	212	850745	209	997473	421	002527	10 2
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( 52	848472	211	850493	210	997979	421	002021	8 (
53	848599	211	850368	210	998231	421	001769	1 75
2 54 2 55	848726 848852	211 211	850242 850116	210 210	998484	421 421	001516 001263	6 5
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( 58	849232	211	849738	210	999495	421	000505	2 (
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